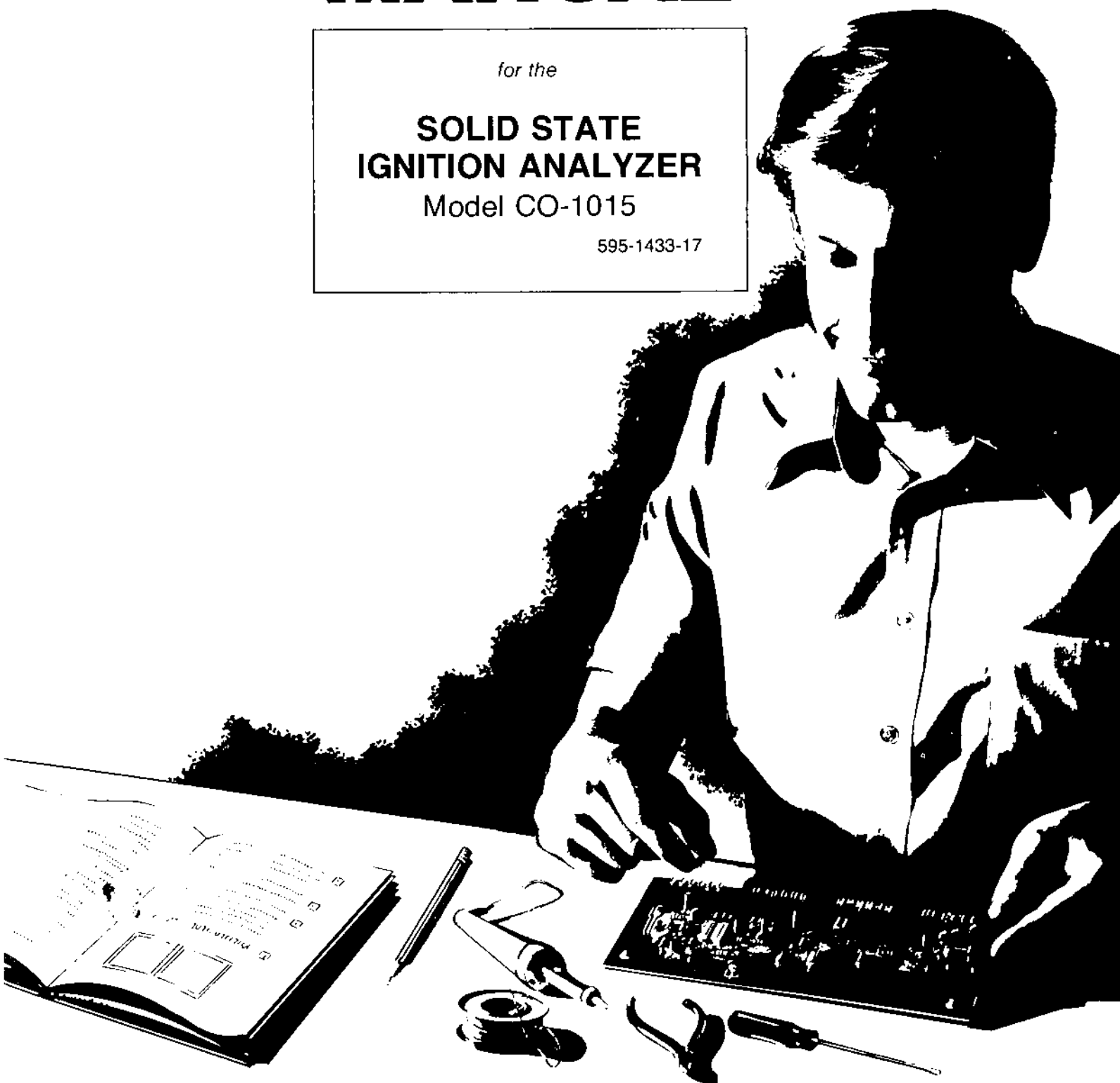


HEATHKIT[®] MANUAL

for the

**SOLID STATE
IGNITION ANALYZER**
Model CO-1015

595-1433-17



HEATH COMPANY • BENTON HARBOR, MICHIGAN

HEATH COMPANY PHONE DIRECTORY

The following telephone numbers are direct lines to the departments listed:

Kit orders and delivery information (616) 982-3411
Credit (616) 982-3561
Replacement Parts (616) 982-3571

Technical Assistance Phone Numbers
8:00 A.M. to 12 P.M. and 1:00 P.M. to 4:30 P.M., EST, Weekdays Only
R/C, Audio, and Electronic Organs (616) 982-3310
Amateur Radio (616) 982-3296
Test Equipment, Weather Instruments and
Home Clocks (616) 982-3315
Television (616) 982-3307
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YOUR HEATHKIT 90-DAY LIMITED WARRANTY

Consumer Protection Plan for Heathkit Consumer Products

Welcome to the Heath family. We believe you will enjoy assembling your kit and will be pleased with its performance. Please read this Consumer Protection Plan carefully. It is a "LIMITED WARRANTY" as defined in the U.S. Consumer Product Warranty and Federal Trade Commission Improvement Act. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Heath's Responsibility

PARTS — Replacements for factory defective parts will be supplied free for 90 days from date of purchase. Replacement parts are warranted for the remaining portion of the original warranty period. You can obtain warranty parts direct from Heath Company by writing or telephoning us at (616) 982-3571. And we will pay shipping charges to get those parts to you . . . anywhere in the world.

SERVICE LABOR — For a period of 90 days from the date of purchase, any malfunction caused by defective parts or error in design will be corrected at no charge to you. You must deliver the unit at your expense to the Heath factory, any Heathkit Electronic Center (units of Ventech Electronics Corporation), or any of our authorized overseas distributors.

TECHNICAL CONSULTATION — You will receive free consultation on any problem you might encounter in the assembly or use of your Heathkit product. Just drop us a line or give us a call. Sorry, we cannot accept collect calls.

NOT COVERED — The correction of assembly errors, adjustments, calibration, and damage due to misuse, abuse, or negligence are not covered by the warranty. Use of corrosive solder and/or the unauthorized modification of the product or of any furnished component will void this warranty in its entirety. This warranty does not include reimbursement for inconvenience, loss of use, customer assembly, set-up time, or unauthorized service.

This warranty covers only Heath products and is not extended to other equipment or components that a customer uses in conjunction with our products.

SUCH REPAIR AND REPLACEMENT SHALL BE THE SOLE REMEDY OF THE CUSTOMER AND THERE SHALL BE NO LIABILITY ON THE PART OF HEATH FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO ANY LOSS OF BUSINESS OR PROFITS, WHETHER OR NOT FORSEEABLE.

Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

Owner's Responsibility

EFFECTIVE WARRANTY DATE — Warranty begins on the date of first consumer purchase. You must supply a copy of your proof of purchase when you request warranty service or parts.

ASSEMBLY — Before seeking warranty service, you should complete the assembly by carefully following the manual instructions. Heathkit service agencies cannot complete assembly and adjustments that are customer's responsibility.

ACCESSORY EQUIPMENT — Performance malfunctions involving other non-Heath accessory equipment, (antennas, audio components, computer peripherals and software, etc.) are not covered by this warranty and are the owner's responsibility.

SHIPPING UNITS — Follow the packing instructions published in the assembly manuals. Damage due to inadequate packing cannot be repaired under warranty.

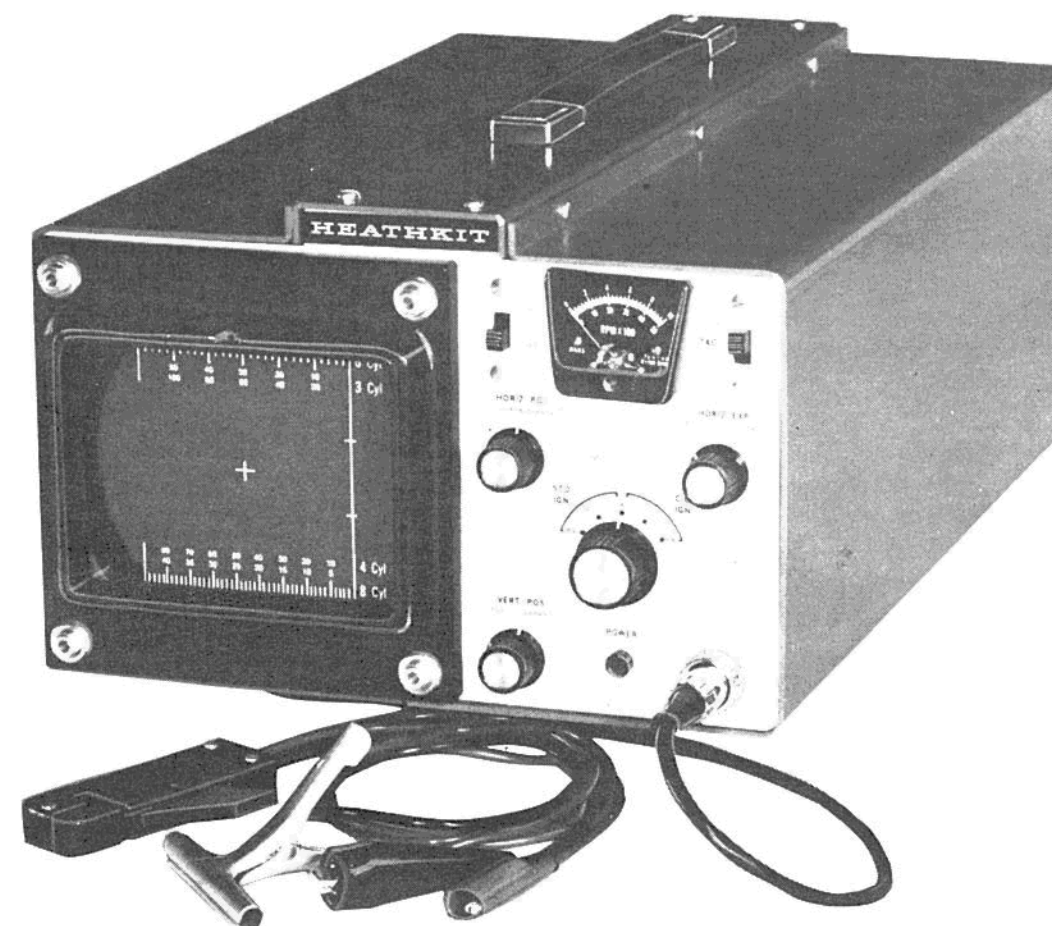
If you are not satisfied with our service (warranty or otherwise) or our products, write directly to our Director of Customer Service, Heath Company, Benton Harbor MI 49022. He will make certain your problems receive immediate, personal attention.

Heathkit® Manual

for the

SOLID STATE IGNITION ANALYZER Model CO-1015

595-1433-17



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BENTON HARBOR, MICHIGAN 49022

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INTRODUCTION

The Heathkit Model CO-1015 Solid-State Ignition Analyzer is an ideal test instrument for use by garage mechanics, service station operators, and auto hobbyists. A pickup cable assembly transfers the electrical pulses produced by the engine ignition system into the Analyzer where they are displayed on the CRT screen. This display enables the operator to determine if each component in the ignition system is operating properly. Both conventional and capacitive discharge ignition systems may be checked by turning the Selector switch to the appropriate position. The connection procedure is the same for both systems.

The Function switch also allows you to display secondary or primary patterns of either ignition system.

This Analyzer has two special features as follows:

1. A built-in "calibrate" signal to properly adjust the sweep length of the pattern.
2. The sweep length of the pattern, as set during the calibration adjustment, will be maintained regardless of engine rpm.

The flat face CRT provides a clear in-focus pattern over the entire viewing area. The screen (graticule) has two scales

marked in degrees. The upper scale is used when you check three or six cylinder engines; the lower scale, when you check four or eight cylinder engines. This provides rapid checking of distributor dwell angle regardless of the number of engine cylinders. A special alloy shield around the cathode ray tube shields the tube from stray magnetic fields that could have an effect on the displayed patterns.

The Ignition Analyzer should be regarded as a special tool to rapidly check or troubleshoot the operation of an ignition system. As with many other special tools, ability to use the Analyzer to its greatest advantage will come with continued use. Interpretation of the patterns obtained will indicate if the ignition system is operating properly. If a malfunction is indicated, careful examination of the area of the pattern that is incorrect should indicate the system component that is the cause of the trouble.

An optional accessory power inverter, Model COA-1015-1, is available which allows the Analyzer to be operated from the car battery. This makes it possible to monitor the operation of the engine even while the car is moving.

Refer to the "Kit Builders Guide" for information on parts, tools, wiring, and soldering.



ASSEMBLY NOTES

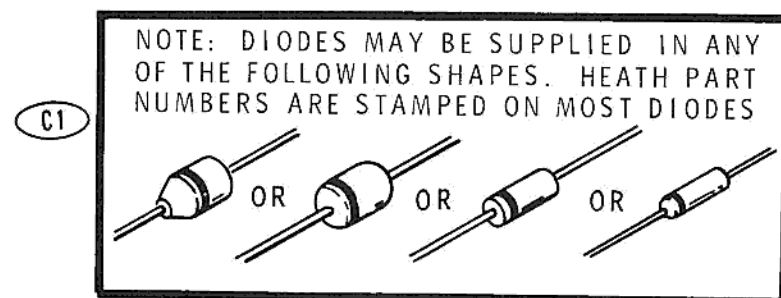
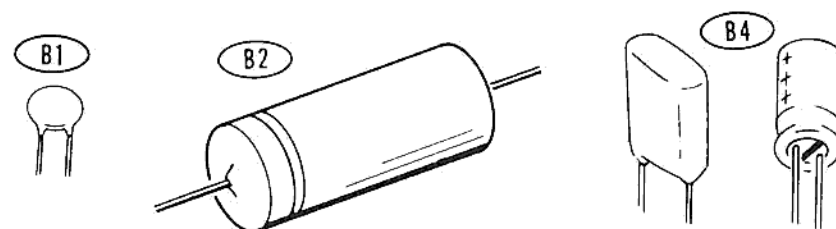
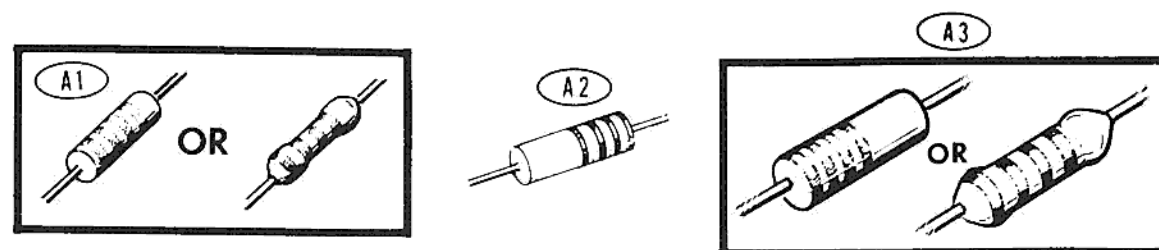
The assembly of your Solid-State Ignition Analyzer is divided into two sections, "Circuit Board" and "Chassis." Each section has its own Parts List and Parts Pictorial.

You will be directed first to open the box marked Pack #1. This will contain the parts needed to construct the circuit board. In addition, you will be directed to remove the

circuit board from the large carton. The parts that remain in the large carton after the circuit board has been assembled will be part of the chassis assembly.

NOTE: Resistors will be identified by resistance value in ohms (Ω , $k\Omega$, or $M\Omega$) and color code. Capacitors will be identified by capacitance value (pF or μF) and type (disc, electrolytic, Mylar, etc.).

CIRCUIT BOARD PARTS PICTORIAL



CIRCUIT BOARD

PARTS LIST

Open pack #1 and check each part against the following list. The key numbers correspond to the numbers on the Circuit Board Parts Pictorial (on Pages 6 and 8). Any part that is packaged in an individual envelope with a part number on it should be placed back in its envelope after it is identified until it is called for in a step.

KEY PART	PARTS	DESCRIPTION
No.	No.	Per Kit

RESISTORS, 1/2-Watt

NOTE: The following are 10% resistors unless otherwise indicated.

A1	6-101	1	100 Ω (brown-black-brown)
A1	6-221	1	220 Ω (red-red-brown)
A1	6-471	2	470 Ω (yellow-violet-brown)
A1	6-102	5	1000 Ω (brown-black-red)
A1	6-152	1	1500 Ω (brown-green-red)
A1	6-222	2	2200 Ω (red-red-red)
A1	6-242	1	2400 Ω , 5% (red-yellow-red-gold)
A1	6-332	2	3300 Ω (orange-orange-red)
A1	6-472	6	4700 Ω (yellow-violet-red)
A1	6-822	1	8200 Ω (gray-red-red)
A1	6-103	14	10 k Ω (brown-black-orange)
A1	6-223	1	22 k Ω (red-red-orange)
A1	6-473	4	47 k Ω (yellow-violet-orange)
A1	6-104	3	100 k Ω (brown-black-yellow)
A1	6-224	1	220 k Ω (red-red-yellow)
A1	6-474	1	470 k Ω (yellow-violet-yellow)
A1	6-105	2	1 M Ω (brown-black-green)

KEY PART	PARTS	DESCRIPTION
No.	No.	Per Kit

Other Resistors

A2	1-34-1	1	1 M Ω , 1-watt (brown-black-green)
A2	1-36-1	2	2.2 M Ω , 1-watt (red-red-green)
A3	6-473-2	4	47 k Ω , 2-watt, 5% (yellow-violet-orange)

CAPACITORS

B1	21-140	2	.001 μ F disc
B1	21-16	2	.01 μ F disc
B1	21-48	1	.05 μ F disc
B2	23-115	1	.1 μ F, 2000 V (2.0 kV) paper tubular
B3	27-161	1	.01 μ F Mylar*
B3	27-85	1	.22 μ F Mylar
B4	25-117	2	100 μ F vertical mount electrolytic

DIODES

NOTE: Diodes may be marked with a part number, type number, or color bands.

C1	56-26	1	1N191 (brown-white-brown)
C1	57-52	2	5D20
C1	57-27	3	1N2071 silicon
C1	56-25	1	1N4166A zener
C1	56-59	1	1N750A zener, (violet-green-black-brown)

*DuPont Registered Trademark



KEY PART No.	PARTS No.	DESCRIPTION
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TRANSISTORS

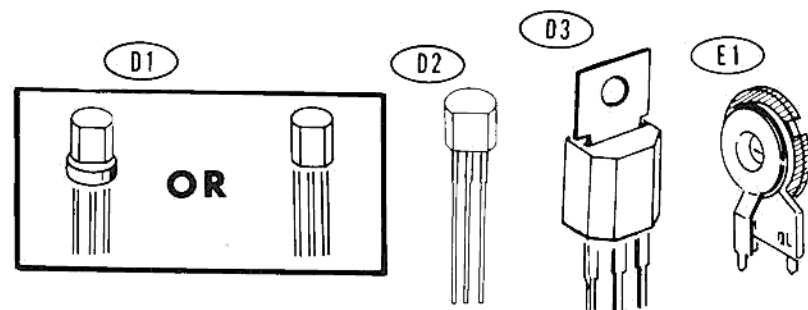
NOTE: Transistors are marked for identification in one of the following ways:

1. Part number.
2. Type number.
3. Part number and type number.
4. Part number with a type number other than the one listed.

D1	417-118	11	2N3393
D1	417-201	8	X29A829
D2	417-241	1	EL131
D3	417-834	4	MPSU10

To order a replacement part, use the Parts Order Form furnished with this kit. If a Parts Order Form is not available, refer to "Replacement Parts" inside the rear cover of the Manual. For pricing information, refer to the separate "Heath Parts Price List."

CIRCUIT BOARD PARTS PICTORIAL (Cont'd.)



STEP-BY-STEP ASSEMBLY

NOTE: Before you start to assemble this kit, read the "Kit Builders Guide" for information on wiring and soldering.

KEY PART No.	PARTS No.	DESCRIPTION
-----------------	--------------	-------------

MISCELLANEOUS

E1	10-918	1	500 Ω control
E1	10-318	1	2000 Ω control Solder

PARTS FROM FINAL PACK

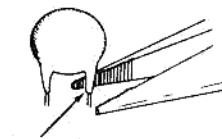
85-2100-1	1	Circuit board
597-308	1	Kit Builders Guide Assembly Manual (See Page 1 for part number.)



START

Position the circuit board as shown in Pictorial 1-1. Then complete each step before you proceed to the next Pictorial.

NOTE: Before you install disc capacitors, remove any insulation on the leads near the body of the capacitors as shown below.



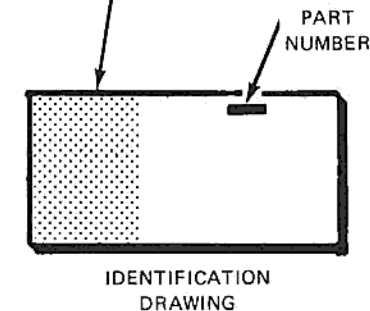
REMOVE INSULATION ON LEADS

- () .001 μ F disc.
- () 470 Ω (yellow-violet-brown).
- () 47 k Ω (yellow-violet-orange).
- () .05 μ F disc.
- () 10 k Ω (brown-black-orange).
- () 10 k Ω (brown-black-orange).
- () 4700 Ω (yellow-violet-red).
- () 10 k Ω (brown-black-orange).
- () 10 k Ω (brown-black-orange).
- () .01 μ F Mylar.
- () 2200 Ω (red-red-red).

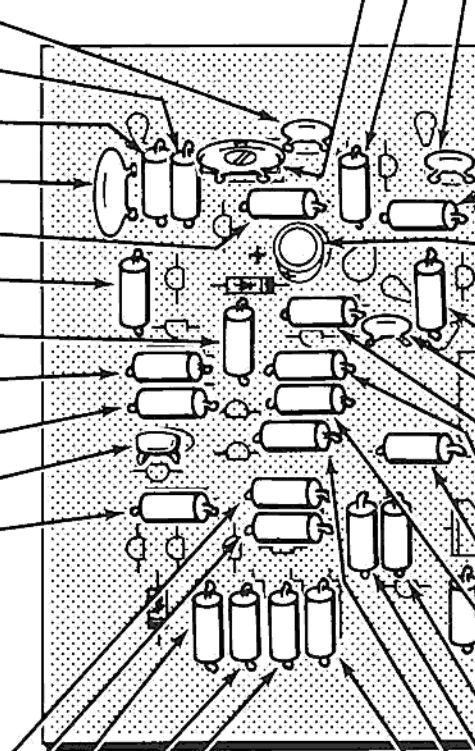
FOR GOOD SOLDERED CONNECTIONS, YOU MUST KEEP THE SOLDERING IRON TIP CLEAN. WIPE IT OFTEN WITH A DAMP SPONGE OR CLOTH.

- () Solder the leads to the foil and cut off the excess lead lengths.
- () 10 k Ω (brown-black-orange).
- () 10 k Ω (brown-black-orange).
- () 470 Ω (yellow-violet-brown).
- () 1000 Ω (brown-black-red).
- () 2400 Ω , 5% (red-yellow-red-gold).
- () Solder the leads to the foil and cut off the excess lead lengths.

The steps performed in this Pictorial are in this area of the circuit board.

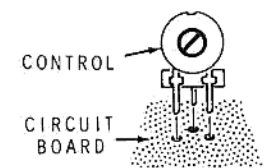


IDENTIFICATION DRAWING



PICTORIAL 1-1

CONTINUE

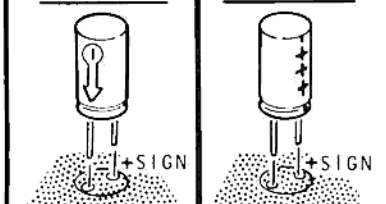


- () 2000 Ω control (#10-318). Solder the leads to the foil.

- () 10 k Ω (brown-black-orange).
- () .01 μ F disc.
- () 47 k Ω (yellow-violet-orange).

NOTE: Before you install an electrolytic capacitor, look at it and identify the leads. One lead will have a plus (+) mark or a minus (-) mark near it. Be sure to install the positive lead in the positive-marked hole. Be careful; only the negative lead may be marked.

IDENTIFIED LEAD IS NEGATIVE (-) IDENTIFIED LEAD IS POSITIVE (+)



- () 100 μ F vertical mounting electrolytic. Mount this type of capacitor as shown; then solder the leads to the foil.

- () 10 k Ω (brown-black-orange).
- () .001 μ F disc.
- () 470 k Ω (yellow-violet-yellow).
- () Solder the leads to the foil and cut off the excess lead lengths.
- () 1000 Ω (brown-black-red).
- () 4700 Ω (yellow-violet-red).
- () 10 k Ω (brown-black-orange).
- () 3300 Ω (orange-orange-red).
- () 10 k Ω (brown-black-orange).
- () 10 k Ω (brown-black-orange).
- () 100 k Ω (brown-black-yellow).
- () 10 k Ω (brown-black-orange).
- () Solder the leads to the foil and cut off the excess lead lengths.



The steps performed in this Pictorial are in this area of the circuit board.

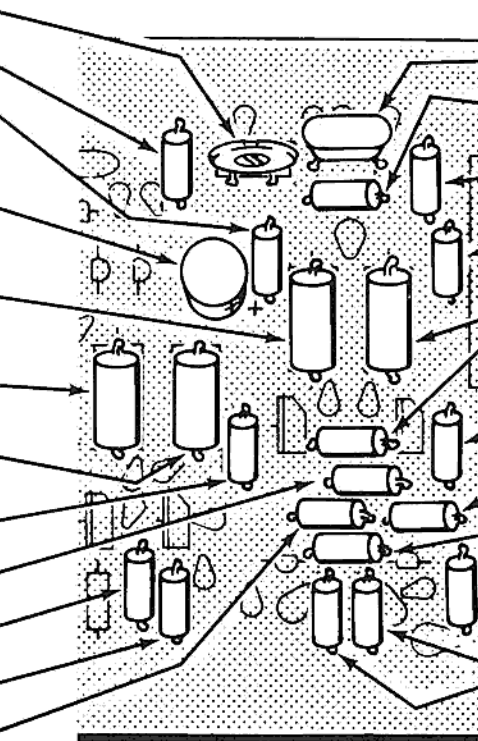
PART NUMBER

IDENTIFICATION DRAWING

START

NOTE: In the next step, solder the lugs to the foil when you mount the control. Do not cut off the excess lug lengths.

- () 500 Ω control (#10-918).
- () 8200 Ω (gray-red-red).
- () 1000 Ω (brown-black-red).
- () 100 μ F vertical mounting electrolytic. Position the positive (+) lead as shown on the circuit board; then solder the leads to the foil.
- () 47 k Ω , 2-watt (yellow-violet-orange).
- () 47 k Ω , 2-watt (yellow-violet-orange).
- () 47 k Ω , 2-watt (yellow-violet-orange).
- () 10 k Ω (brown-black-orange).
- () 4700 Ω (yellow-violet-red).
- () 220 Ω (red-red-brown).
- () 3300 Ω (orange-orange-red).
- () 4700 Ω (yellow-violet-red).
- () Solder the leads to the foil and cut off the excess lead lengths.



PICTORIAL 1-2

CONTINUE

- () .22 μ F Mylar.
- () 1 M Ω (brown-black-green).
- () 22 k Ω (red-red-orange).
- () 100 k Ω (brown-black-yellow).
- () 47 k Ω , 2-watt (yellow-violet-orange).
- () 2200 Ω (red-red-red).
- () 10 k Ω (brown-black-orange).
- () 1000 Ω (brown-black-red).
- () 1500 Ω (brown-green-red).
- () 100 k Ω (brown-black-yellow).
- () 4700 Ω (yellow-violet-red).
- () 4700 Ω (yellow-violet-red).
- () Solder the leads to the foil and cut off the excess lead lengths.

The steps performed in this Pictorial are in this area of the circuit board.

PART NUMBER

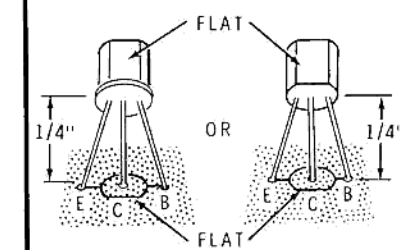
IDENTIFICATION DRAWING

START

FOR GOOD SOLDER CONNECTIONS, YOU MUST KEEP THE SOLDERING IRON TIP CLEAN... WIPE IT OFTEN WITH A DAMP SPONGE OR CLOTH.

- () 2.2 M Ω , 1-watt (red-red-green).
- () .1 μ F, 2000 (2.0 kV) paper tubular (#23-115). NOTE: Mount this capacitor so the banded end is positioned as shown in the Pictorial.
- () 2.2 M Ω , 1-watt (red-red-green).
- () 1 M Ω , 1-watt (brown-black-green).
- () .01 μ F disc.
- () 1000 Ω (brown-black-red).
- () 47 k Ω (yellow-violet-orange).
- () 47 k Ω (yellow-violet-orange).
- () Solder the leads to the foil and cut off the excess lead lengths.

NOTE: When you install each of the following transistors (#417-118), line up the flat on the transistor with the outline of the flat on the circuit board. Then insert the E, C, and B leads of the transistor into the corresponding E, C, and B holes in the circuit board. Position the transistor 1/4" above the circuit board. Then solder the leads to the foil and cut off the excess lead lengths.

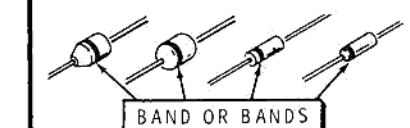


- () 2N3393 transistor (#417-118) at Q601.
- () 2N3393 transistor (#417-118) at Q901.

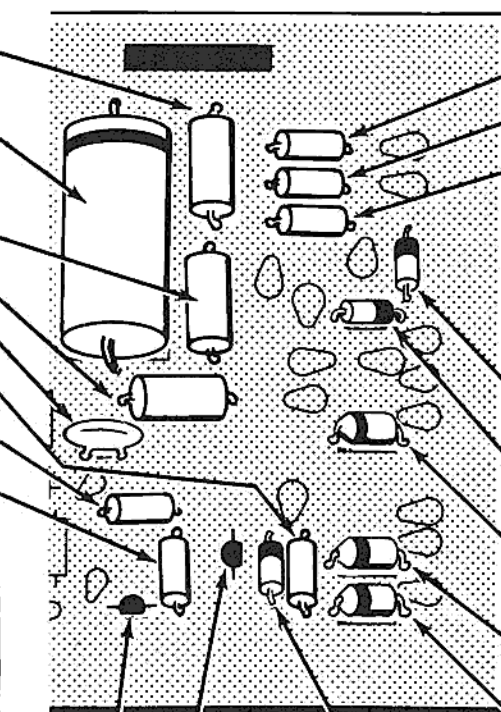
CONTINUE

- () 100 Ω (brown-black-brown).
- () 1 M Ω (brown-black-green).
- () 220 k Ω (red-red-yellow).

NOTE: ALWAYS POSITION THE BANDED END OF A DIODE AS SHOWN ON THE CIRCUIT BOARD.



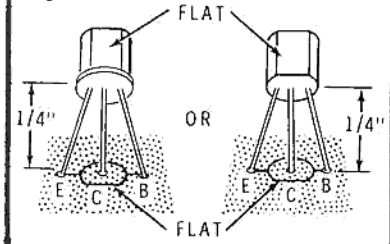
- () 5D20 silicon diode (#57-52) at D905.
- () 5D20 silicon diode (#57-52) at D904.
- () 1N2071 silicon diode (#57-27) at D903.
- () 1N2071 silicon diode (#57-27) at D902.
- () 1N2071 silicon diode (#57-27) at D901.
- () 1N4166A zener diode (#56-25) at D906.
- () Solder the leads to the foil and cut off the excess lead lengths.



PICTORIAL 1-3

START

NOTE: When you install a 2N3393 or X29A829 transistor, line up the flat on the transistor with the outline of the flat on the circuit board. Then insert the E, C, and B leads of the transistor into the corresponding E, C, and B holes in the circuit board. Position the transistor 1/4" above the circuit board. Solder the leads to the foil and cut off the excess lead lengths.



() X29A829 transistor (#417-201) at Q301.

() X29A829 transistor (#417-201) at Q302.

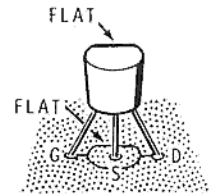
() X29A829 transistor (#417-201) at Q303.

() 2N3393 transistor (#417-118) at Q409.

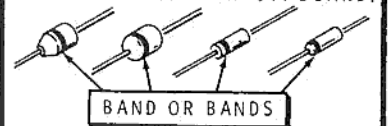
() 2N3393 transistor (#417-118) at Q403.

() X29A829 transistor (#417-201) at Q402.

() EL131 transistor (#417-241) at Q404. NOTE: The circuit board holes are marked G, S, and D for this transistor.

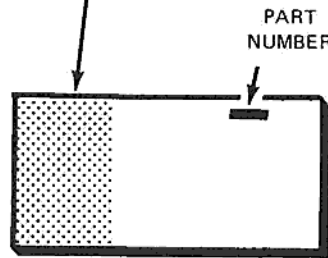


NOTE: DIODES MAY BE SUPPLIED IN ANY OF THE FOLLOWING SHAPES. ALWAYS POSITION THE BANDED END AS SHOWN ON THE CIRCUIT BOARD.



() 56-59 diode (violet-green-black-brown) at D701. Solder the leads to the foil and cut off the excess lead lengths.

The steps performed in this Pictorial are in this area of the circuit board.



IDENTIFICATION
DRAWING

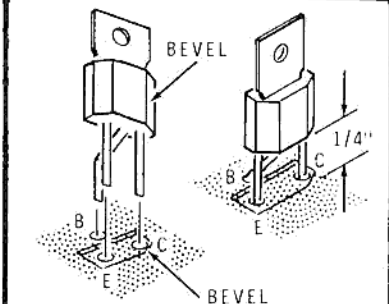
CONTINUE

() 56-26 diode (brown-white-brown 1N191) at D401. Solder the leads to the foil and cut off the excess lead lengths.

() 2N3393 transistor (#417-118) at Q304.

() 2N3393 transistor (#417-118) at Q401.

() X29A829 transistor (#417-201) at Q501.



() MPSU10 transistor (#417-834) at Q702. NOTE: Form the B lead as shown. Be sure you mount the transistor so a beveled edge is positioned over the outline of the bevel on the circuit board.

() X29A829 transistor (#417-201) at Q408.

() 2N3393 transistor (#417-118) at Q407.

() 2N3393 transistor (#417-118) at Q406.

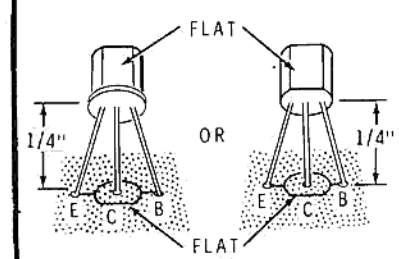
() 2N3393 transistor (#417-118) at Q405.

() X29A829 transistor (#417-201) at Q701.

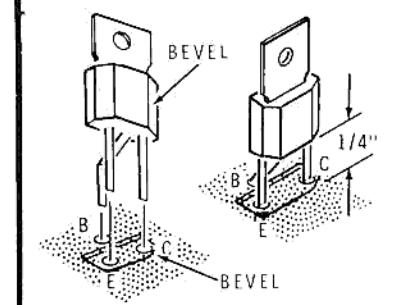
PICTORIAL 1-4

START

NOTE: When you install a 2N3393 or X29A829 transistor, line up the flat on the transistor with the outline of the flat on the circuit board. Then insert the E, C, and B leads of the transistor into the corresponding E, C, and B holes in the circuit board. Position the transistor 1/4" above the circuit board. Solder the leads to the foil and cut off the excess lead lengths.



() X29A829 transistor (#417-201) at Q502.

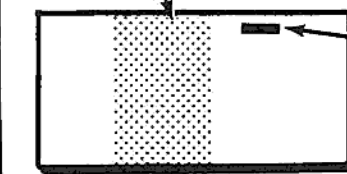


() MPSU10 transistor (#417-834) at Q703. NOTE: Form the B lead as shown. Be sure you mount the transistor so a beveled edge is positioned over the outline of the bevel on the circuit board.

() 2N3393 transistor (#417-118) at Q801.

() 2N3393 transistor (#417-118) at Q802.

The steps performed in this Pictorial are in this area of the circuit board.



PART NUMBER

IDENTIFICATION
DRAWING

CONTINUE

() MPSU10 transistor (#417-834) at Q803.

() MPSU10 transistor (#417-834) at Q804.

CIRCUIT BOARD CHECKOUT

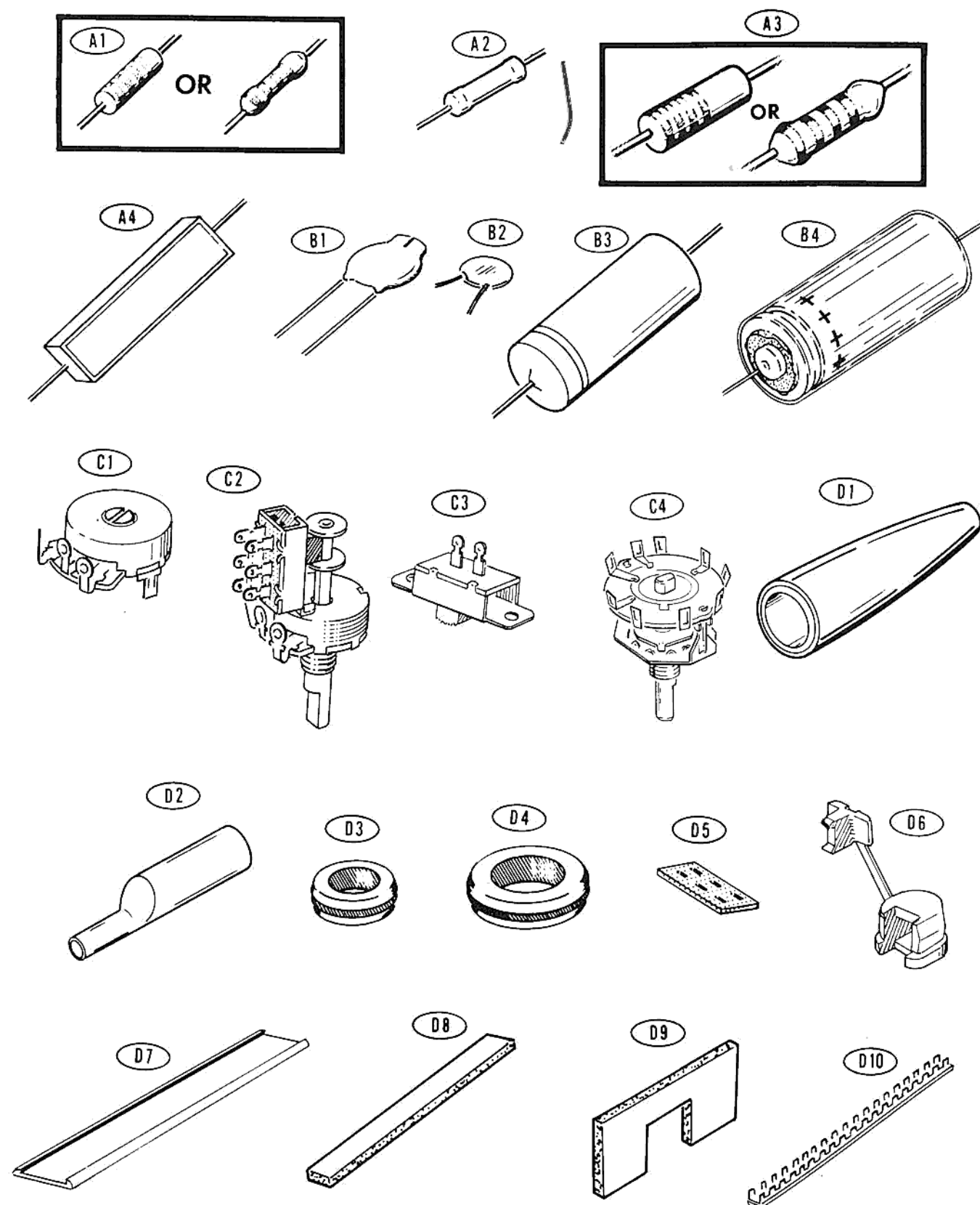
Carefully inspect the circuit board for the following conditions.

- () Unsoldered connections.
- () "Cold" solder connections.
- () Solder bridges between foil patterns.
- () Protruding leads which could touch together.
- () Transistors for the proper type and installation.
- () Electrolytic capacitors for the correct position of the positive (+) end.
- () Diodes for the correct position of the banded end.

This completes the assembly of the circuit board. Set it aside until it is called for in a step.

PICTORIAL 1-5

CHASSIS PARTS PICTORIAL



CHASSIS

PARTS LIST

Check each part against the following list. The key numbers correspond to the numbers on the Chassis Parts Pictorial (on Page 14 and on the fold-out from Page 17). Any part that is packaged in an individual envelope with a part number on it should be placed back in its envelope after it is identified until it is called for later.

To order a replacement part, use the Parts Order Form furnished with this kit. If a Parts Order Form is not available, refer to "Replacement Parts" inside the rear cover of the Manual. For pricing information, refer to the separate "Heath Parts Price List."

KEY PART	PARTS	DESCRIPTION
No.	No.	Per Kit

RESISTORS

1/2-Watt Carbon or Film

NOTE: All 5% and 10% resistors have four color bands (last band gold for 5% and silver for 10%). The last band (gold or silver) will not be referred to.

A1	6-102	1	1000 Ω (brown-black-red)
A1	6-272	1	2700 Ω (red-violet-red)
A1	6-103	2	10 k Ω (brown-black-orange)
A1	6-223	1	22 k Ω (red-red-orange)
A1	6-154	1	150 k Ω (brown-green-yellow)
A1	6-334	1	330 k Ω (orange-orange-yellow)

1% Precision

NOTE: All color coded 1% resistors have five color bands (last band brown). This brown band is set apart from the other bands. The last band (brown) will not be referred to. Some 1% resistors have the value rather than color bands marked on them.

A2	6-7502-12	1	75 k Ω (violet-green-black-red)
A2	6-2253-12	1	225 k Ω (red-red-green-orange)
A2	6-3003-12	1	300 k Ω (orange-black-black-orange)
A2	6-9003-12	1	900 k Ω (white-black-black-orange)

Other Resistors

A3	6-473-2	1	47 k Ω , 2-watt, 5% (yellow-violet-orange)
A4	3-8-7	1	4000 (4 k) Ω , 7-watt

KEY PART	PARTS	DESCRIPTION
No.	No.	Per Kit

CAPACITORS

B1	21-193	1	.005 μ F disc
B2	21-16	1	.01 μ F disc
B2	21-48	1	.05 μ F disc
B3	23-62	2	.1 μ F, 1600 V (1.6 kV) paper tubular
B4	25-43	2	70 μ F, 350 V electrolytic
B4	25-874	1	470 μ F, 50 V electrolytic

CONTROLS-SWITCHES

C1	10-127	2	1 M Ω tab mount control
C2	19-169	3	5000 Ω control/switch
C3	60-1	2	SPST slide switch
C4	63-642	1	Rotary switch

INSULATORS

D1	73-12	1	Black insulator
D2	73-20	1	Red insulator
D3	73-3	2	1/2" grommet
D4	73-2	2	3/4" grommet
D5	75-52	1	Fiber plate
D6	75-71	1	Strain relief
D7	73-5	1	Cushion strip
D8	73-147	1	Foam tape
D9	73-148	2	U-shape foam pad
D10	73-78	1	Grommet strip



KEY PART No. No. PARTS Per Kit DESCRIPTION

TERMINAL STRIPS-COLLAR-CONNECTOR-SOCKETS

E1	431-14	1	2-lug terminal strip
E2	431-39	1	Small 5-lug terminal strip
E3	431-42	2	Large 5-lug terminal strip
E4	431-86	1	6-lug terminal strip
E5	431-82	1	3-lug terminal collar
E6	432-735	1	Cable connector
E7	432-736	1	Connector socket
E8	434-41	1	CRT socket

KNOBS-INSERTS-RETAINERS-FEET

F1	462-280	3	Small knob
F2	462-264	1	Large knob
F3	455-50	4	Knob insert
F4	261-1	7	CRT retainer
F5	261-39	4	Cord retainer
F6	261-34	4	Plastic foot

HARDWARE

NOTE: For your convenience, the "Parts Pictorial" shows the hardware full size.

#3 Hardware

G1	250-49	1	3-48 x 1/4" screw
G2	252-1	1	3-48 nut
G3	254-7	1	#3 lockwasher

#4 Hardware

G4	250-213	2	4-40 x 5/16" screw
G5	252-2	2	4-40 nut

#6 Hardware

G6	250-56	8	6-32 x 1/4" screw
G7	250-89	14	6-32 x 3/8" screw
G8	250-414	2	6-32 x 1" screw
G9	250-591	4	#6 x 1/2" self-tapping screw
G10	252-3	16	6-32 nut
G11	250-8	10	#6 x 3/8" sheet metal screw
G12	250-475	8	#6 x 3/8" hex head sheet metal screw
G13	254-1	26	#6 lockwasher
G14	259-1	1	#6 solder lug

KEY PART No.	No.	PARTS Per Kit	DESCRIPTION
Other Hardware			
H1	250-137	12	8-32 x 3/8" screw
H2	252-4	4	8-32 nut
H3	254-2	8	#8 lockwasher
H4	252-5	2	10-32 nut
H5	254-3	2	#10 lockwasher
H6	252-86	4	Thumbnut
H7	252-73	1	Push-on nut
H8	252-7	4	Control nut
H9	253-10	4	Control flat washer
H10	259-10	2	Control solder lug
H11	250-287	4	3/4" threaded bushing
H12	258-191	1	Spring

METAL PARTS

J1	200-1282	1	Main chassis
J2	204-2174	1	CRT support bracket
J3	203-884-1	1	Front panel
J4	203-885-1	1	Rear panel
J5	204-1809-3	1	Top rail
J6	90-553-2	2	Cabinet half-shell
J7	205-877-1	1	Cover plate
J8	207-1	2	CRT clamp
	206-1216	1	CRT shield
	210-95	1	CRT ring

WIRE-CABLE-HARNESS-SLEEVING

341-1	1	Black wire
341-2	1	Red wire
344-13	1	Blue wire
344-59	1	White wire
347-3	1	2-conductor shielded cable
347-19	1	3-conductor shielded cable
134-811	1	Wiring harness
89-23	1	Line cord
346-1	1	Sleeving



KEY PART No.	No.	PARTS Per Kit	DESCRIPTION
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MISCELLANEOUS

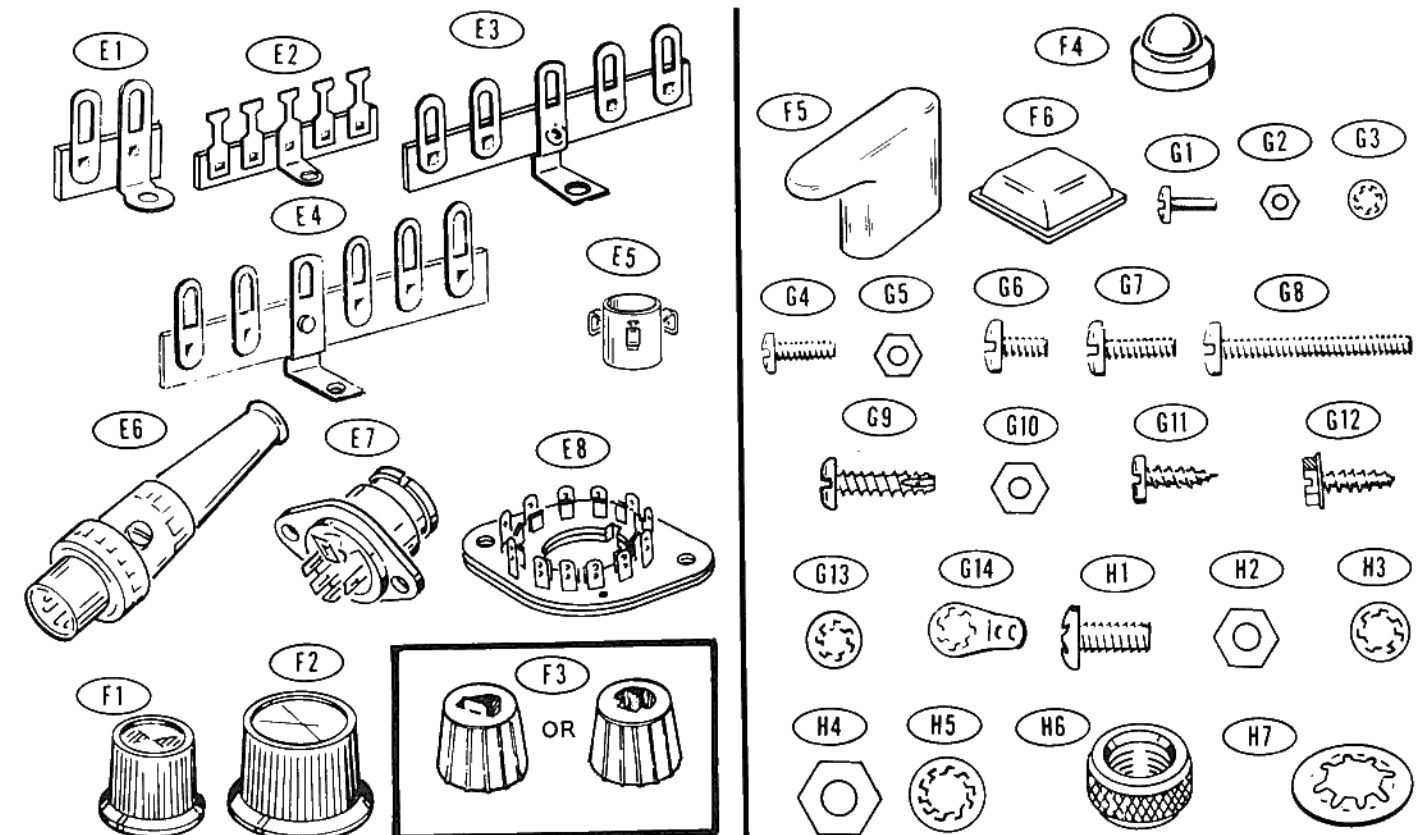
K1	40-1905	1	Pickup inductor
	214-221	1	Housing assembly consisting of:
K2		1	Housing half
K3		1	Housing half
K4		1	Slide actuator
K5	260-52	1	Insulation piercing clip
K6	260-14	1	Ground clip
K7	260-21	1	T clip
K8	56-26	1	1N191 diode (brown-white-brown)
K9	412-15	1	NE-2H neon lamp
K10	413-10	1	Lamp lens
K11	422-1	1	Fuse block
K12	414-25-1	1	Graticule
K13	490-5	1	Nut starter
K14	210-48	1	Bezel

KEY PART No.	No.	PARTS Per Kit	DESCRIPTION
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Miscellaneous (cont'd.)

	54-801	1	Power transformer
	407-171	1	Meter
	411-815	1	5DEP31F CRT
	421-33	1	1/4-ampere slow-blow fuse
K15	475-5	1	RF Core
K16	354-7	1	Cable tie
	211-49	1	Handle
	391-34	1	Blue and white identification label
	391-54	1	Heathkit nameplate
	390-1255	1	Fuse label
	490-71	1	Plastic alignment tool
	597-260	1	Parts Order Form Manual (See front cover for part number.)
	595-1458-4	1	Operation Handbook
K17	260-91	1	HEI Distributor Adapter

CHASSIS PARTS PICTORIAL (Cont'd.)



KEY PART
No. No.

TERMINAL
SOCKETS

- E1 431-14
- E2 431-39
- E3 431-42
- E4 431-86
- E5 431-82
- E6 432-735
- E7 432-736
- E8 434-41

KNOBS-INSE

- F1 462-280
- F2 462-264
- F3 455-50
- F4 261-1
- F5 261-39
- F6 261-34

HARDWARE

NOTE: For you
the hardware full

#3 Hardware

- G1 250-49
- G2 252-1
- G3 254-7

#4 Hardware

- G4 250-213
- G5 252-2

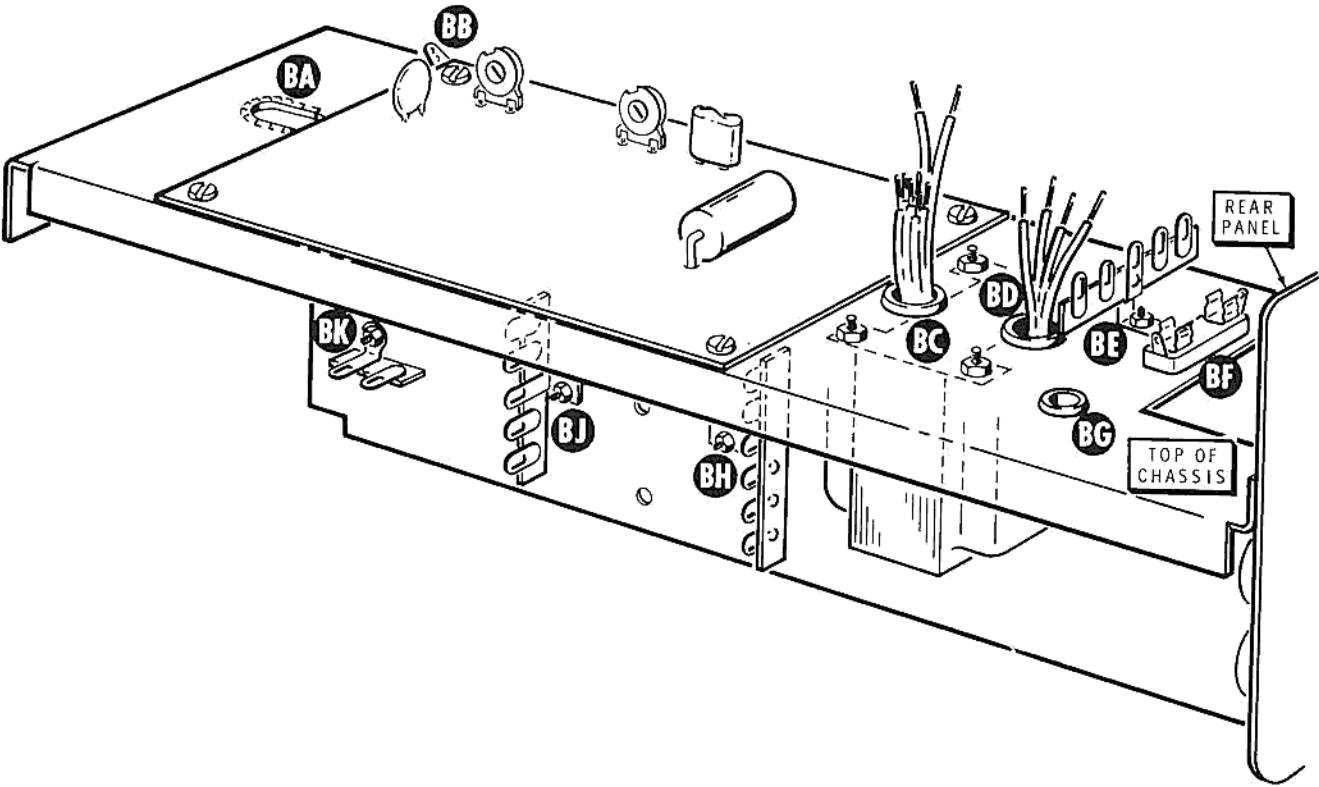
#6 Hardware

- G6 250-56
- G7 250-89
- G8 250-414
- G9 250-591

- G10 252-3
- G11 250-8

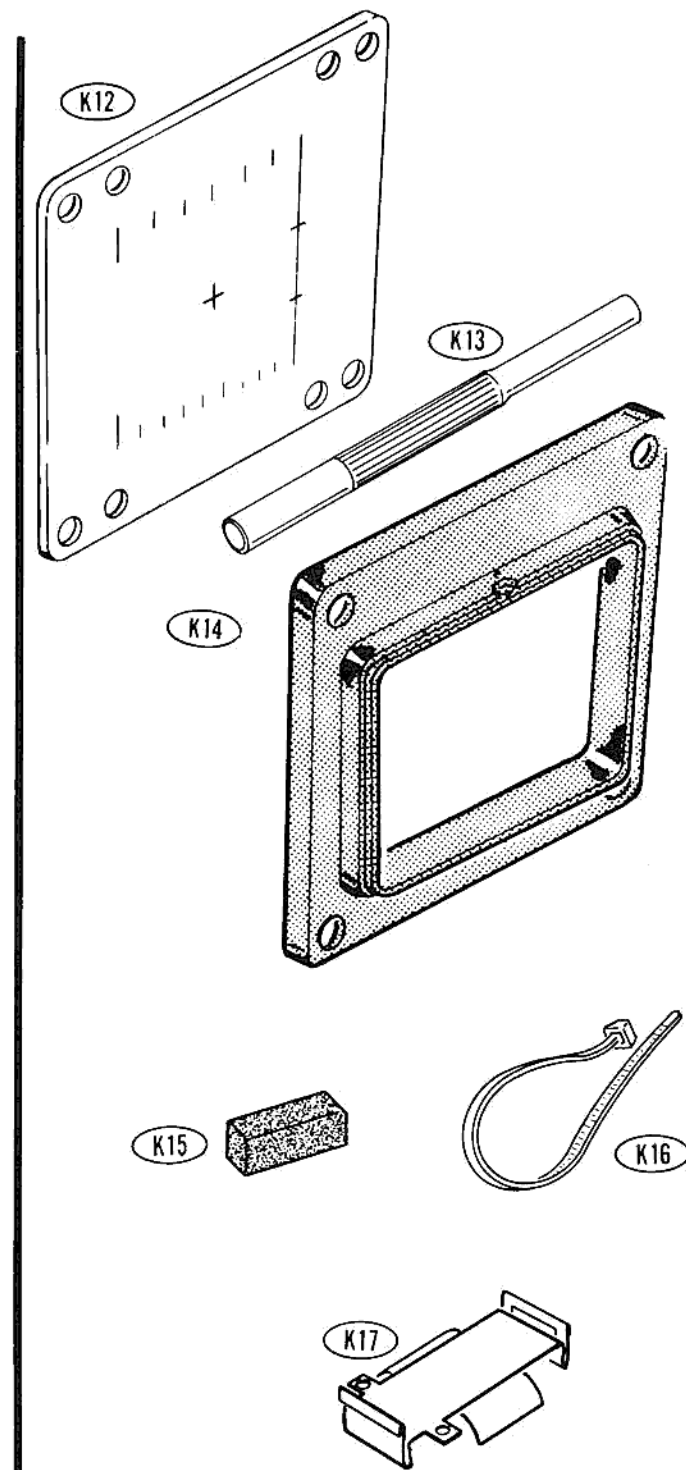
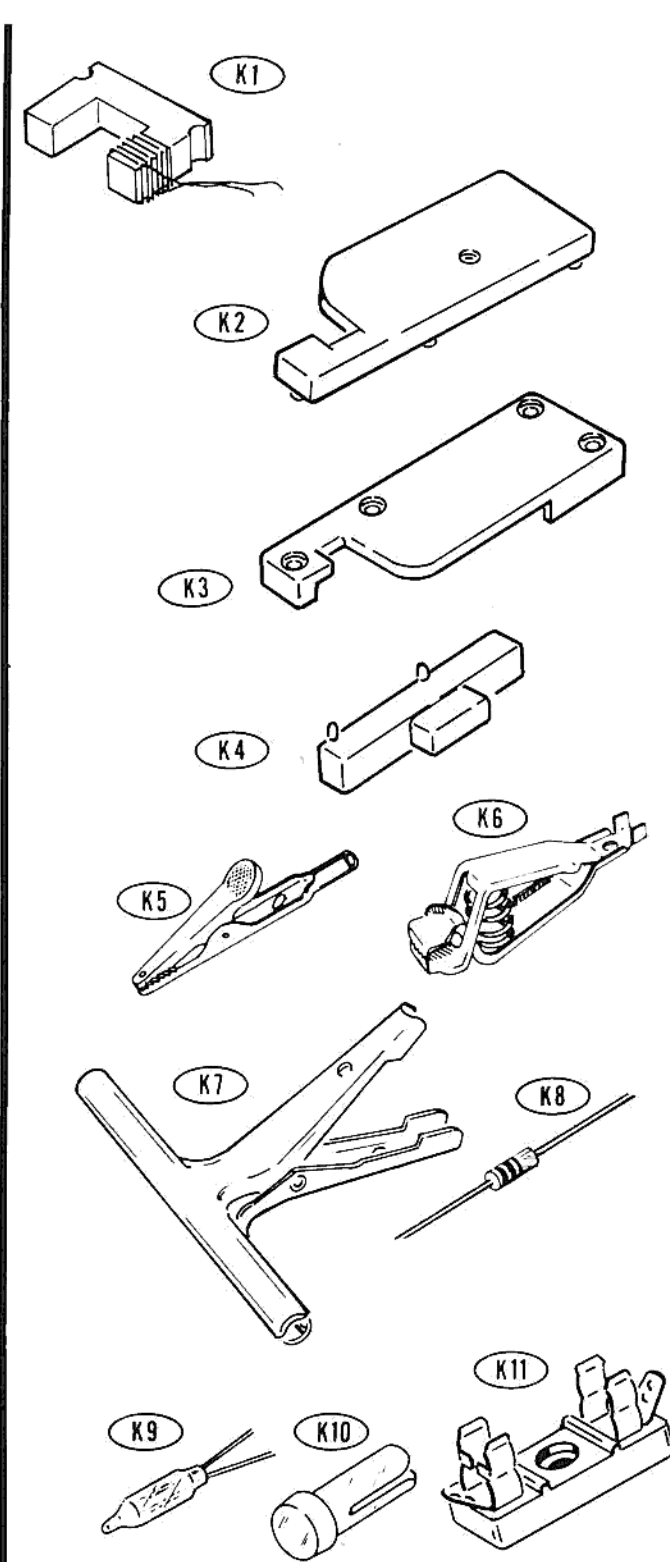
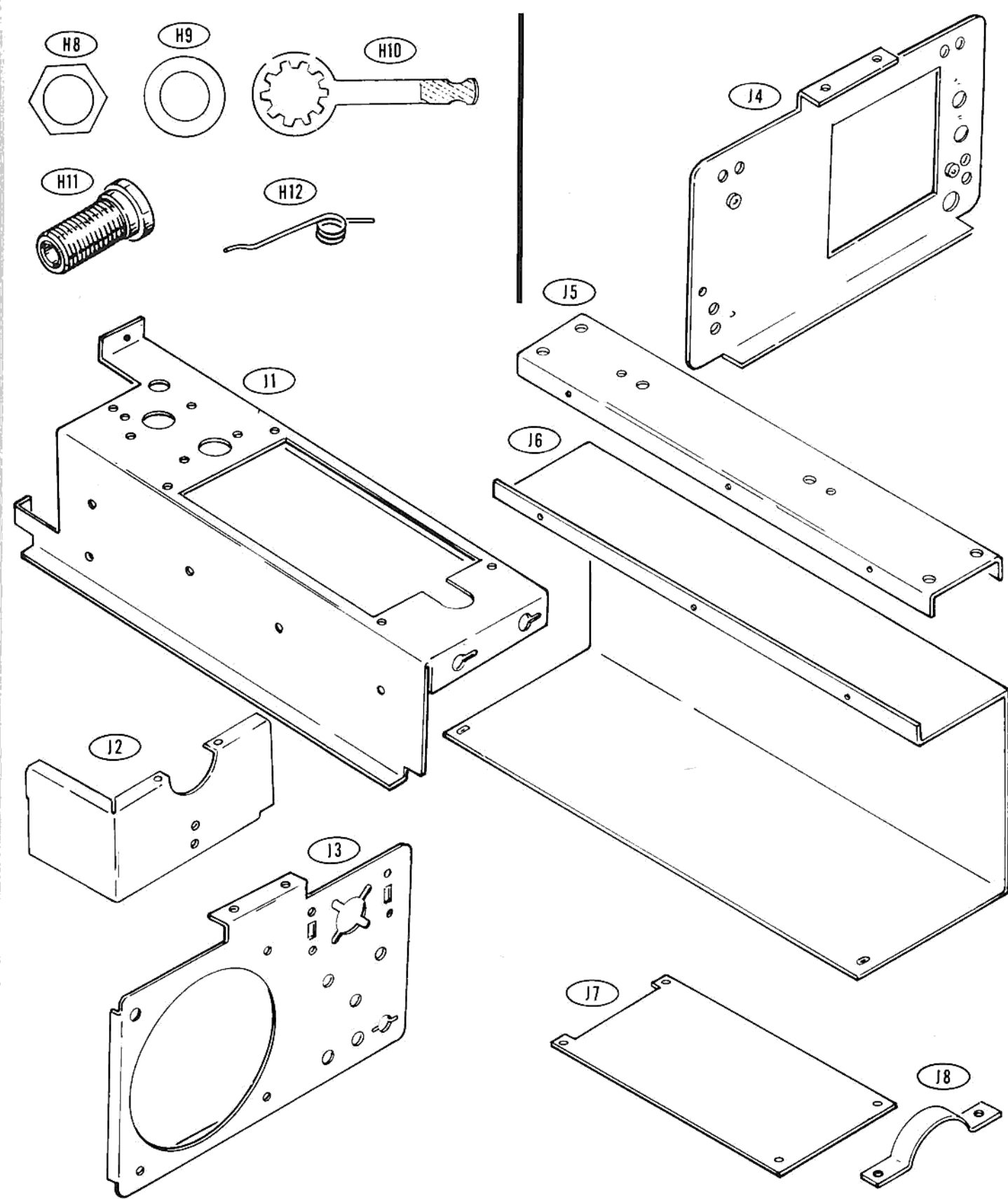
- G12 250-475

- G13 254-1
- G14 259-1



PICTORIAL 2-2

CHASSIS PARTS PICTORIAL (Cont'd.)



Y

ily the screw hardware" is one or more or Pictorial) number of

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HEAD CREW

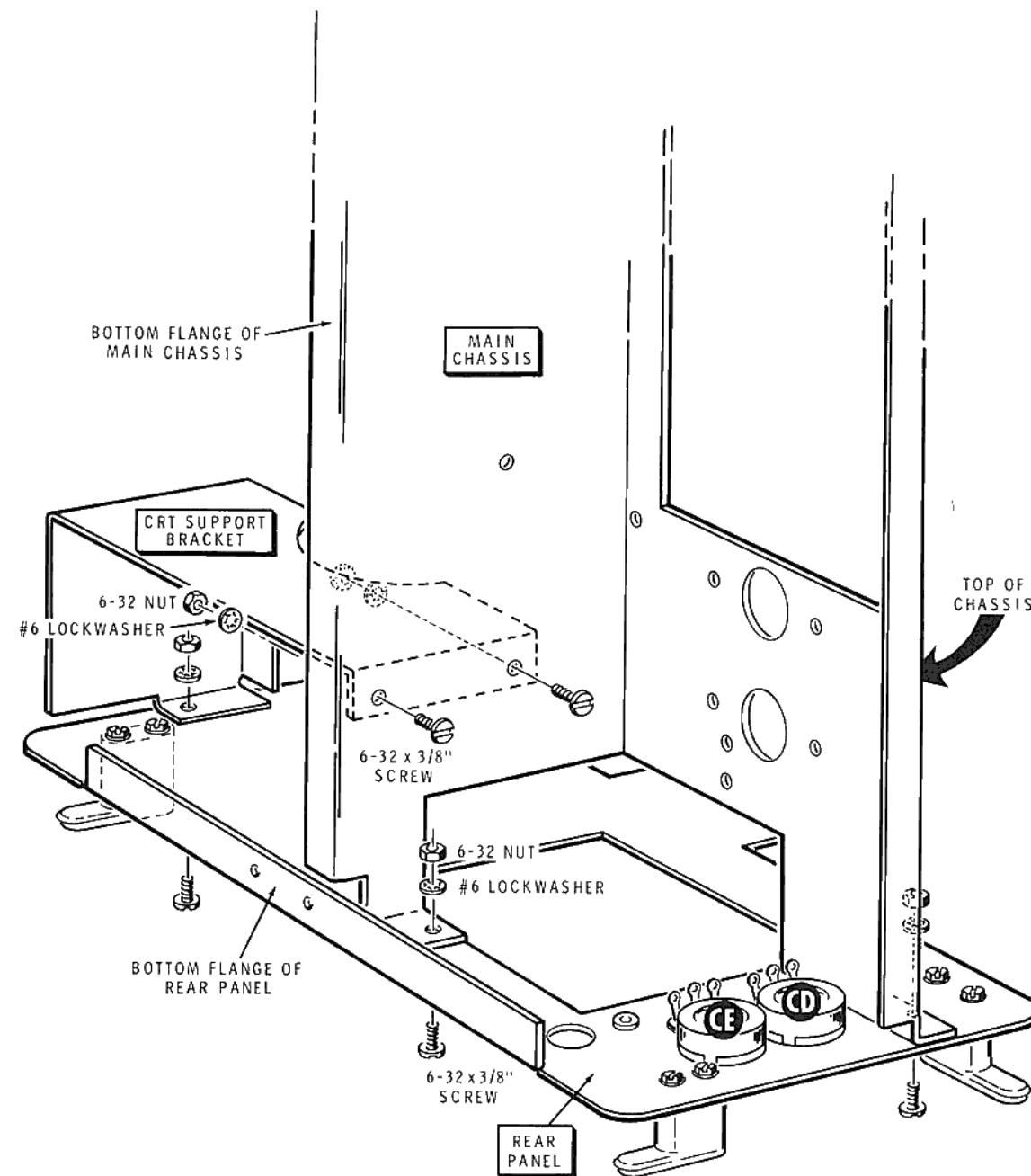
STEP-BY-STEP ASSEMBLY

NOTE: The illustrations in this section of the Manual are called Pictorials and Details. Pictorials show the overall operation for a group of assembly steps. Details are used in addition to the Pictorials to illustrate a single step. When you are directed to refer to a certain Pictorial "for the

following steps," continue using that Pictorial until you are referred to another Pictorial.

REAR PANEL PARTS MOUNTING

Refer to Pictorial 2-1 for the following steps.



PICTORIAL 2-1

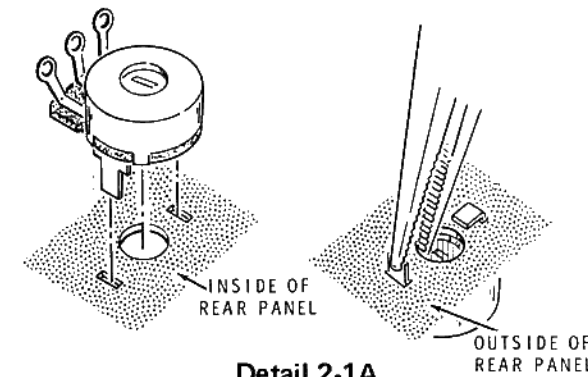
REAR PANEL AND CHASSIS ASSEMBLY

NOTE: When hardware is called for in a step, only the screw size will be given. For instance, if "6-32 x 3/8" hardware" is called for, it means to use a 6-32 x 3/8" screw, one or more #6 lockwashers, and a 6-32 nut. The Detail (or Pictorial) referred to in the step will show the proper number of lockwashers and type of screw to use.

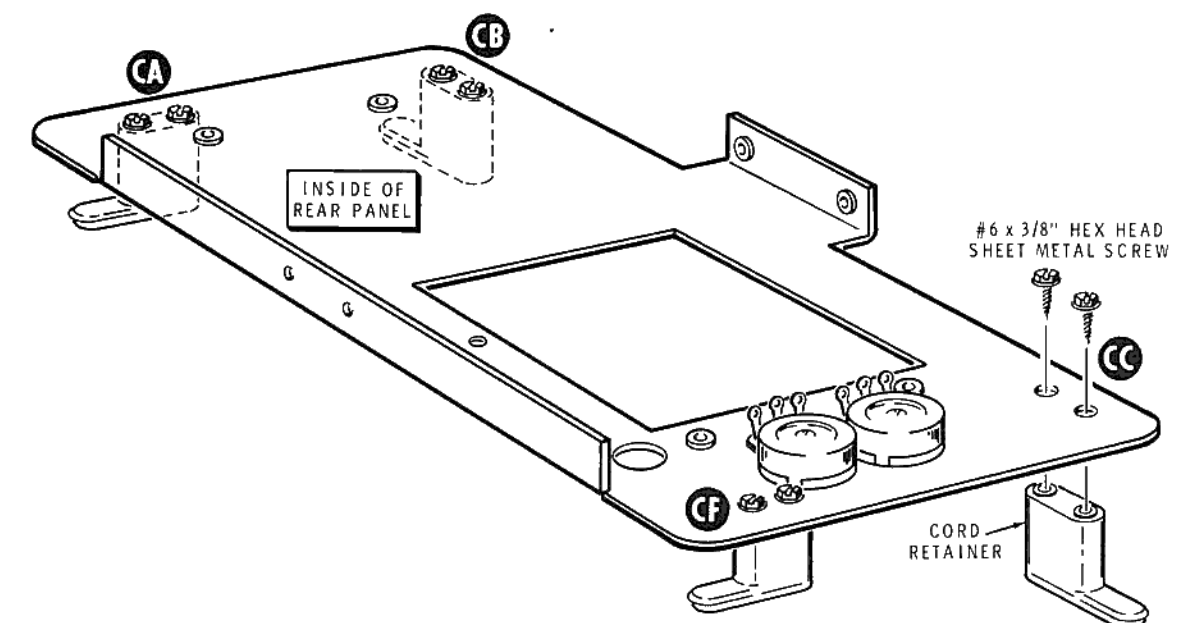
Refer to Pictorial 2-1 for the following steps.

NOTE: In the next two steps, tighten the hardware only finger tight.

- () Refer to Detail 2-1A and mount a 1 MΩ tab-mount control on the inside of the rear panel at CD. Position the control lugs as shown in the Pictorial.
- () In a like manner, mount a 1 MΩ tab-mount control at CE. Be sure both tab-mount controls are firmly mounted.
- () Refer to Detail 2-1B and mount cord retainers on the outside of the rear panel at CA, CB, CC, and CF. Use two #6 x 3/8" hex head sheet metal screws at each location. NOTE: Be sure the shoulders on the retainers are seated in the holes in the rear panel.
- () Mount the main chassis to the rear panel with 6-32 x 3/8" hardware at the two locations shown in the Pictorial.
- () Mount the CRT support bracket to the rear panel and main chassis with 6-32 x 3/8" hardware at the three locations shown in the Pictorial.
- () Position the assembly so the bottom flanges of both the rear panel and main chassis are down flat against your work surface. Then securely tighten all of the 6-32 hardware.



Detail 2-1A

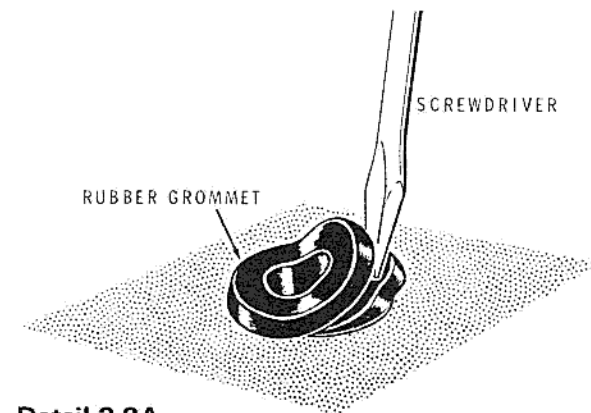


Detail 2-1B



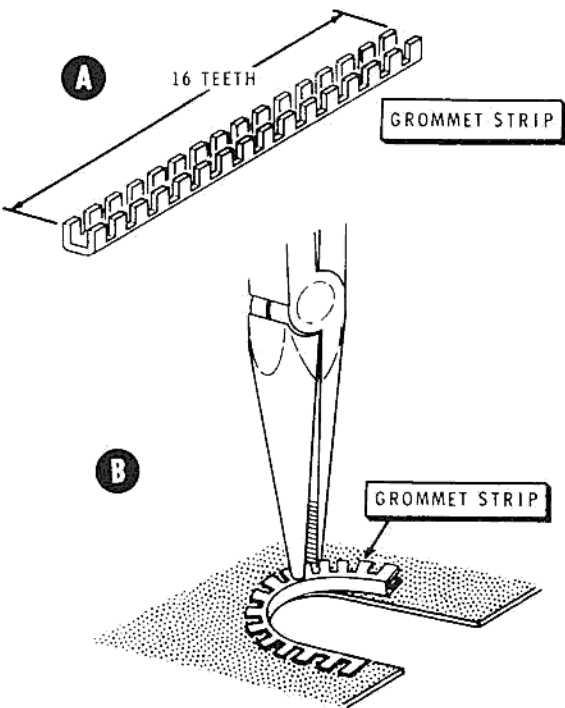
CHASSIS PARTS MOUNTING

Refer to Pictorial 2-2 for the following steps.



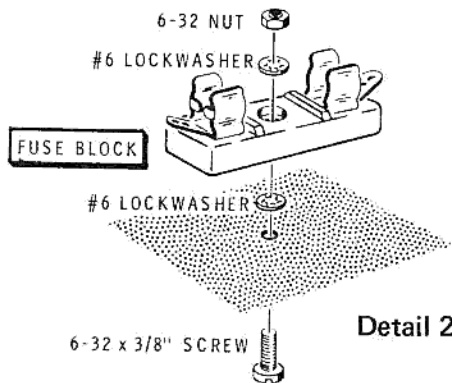
Detail 2-2A

- () Refer to Detail 2-2A and install a 1/2" rubber grommet in hole BG.
- () In a similar manner install 3/4" rubber grommets in holes BD and BC.



Detail 2-2B

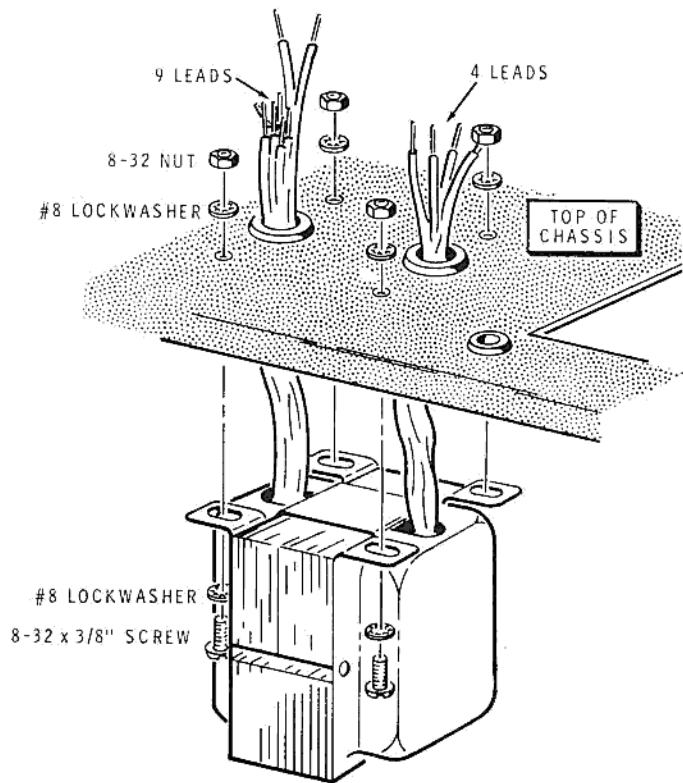
- () Refer to Part A of Detail 2-2B and cut a grommet strip 16 teeth in length. Then install this grommet strip in hole BA as shown in Part B.



Detail 2-2C

- () Refer to Detail 2-2C and mount a fuse block at BF with 6-32 x 3/8" hardware.

NOTE: When you mount the power transformer in the following steps, be sure you insert the proper group of leads through the grommets indicated in Pictorial 2-2.



Detail 2-2D

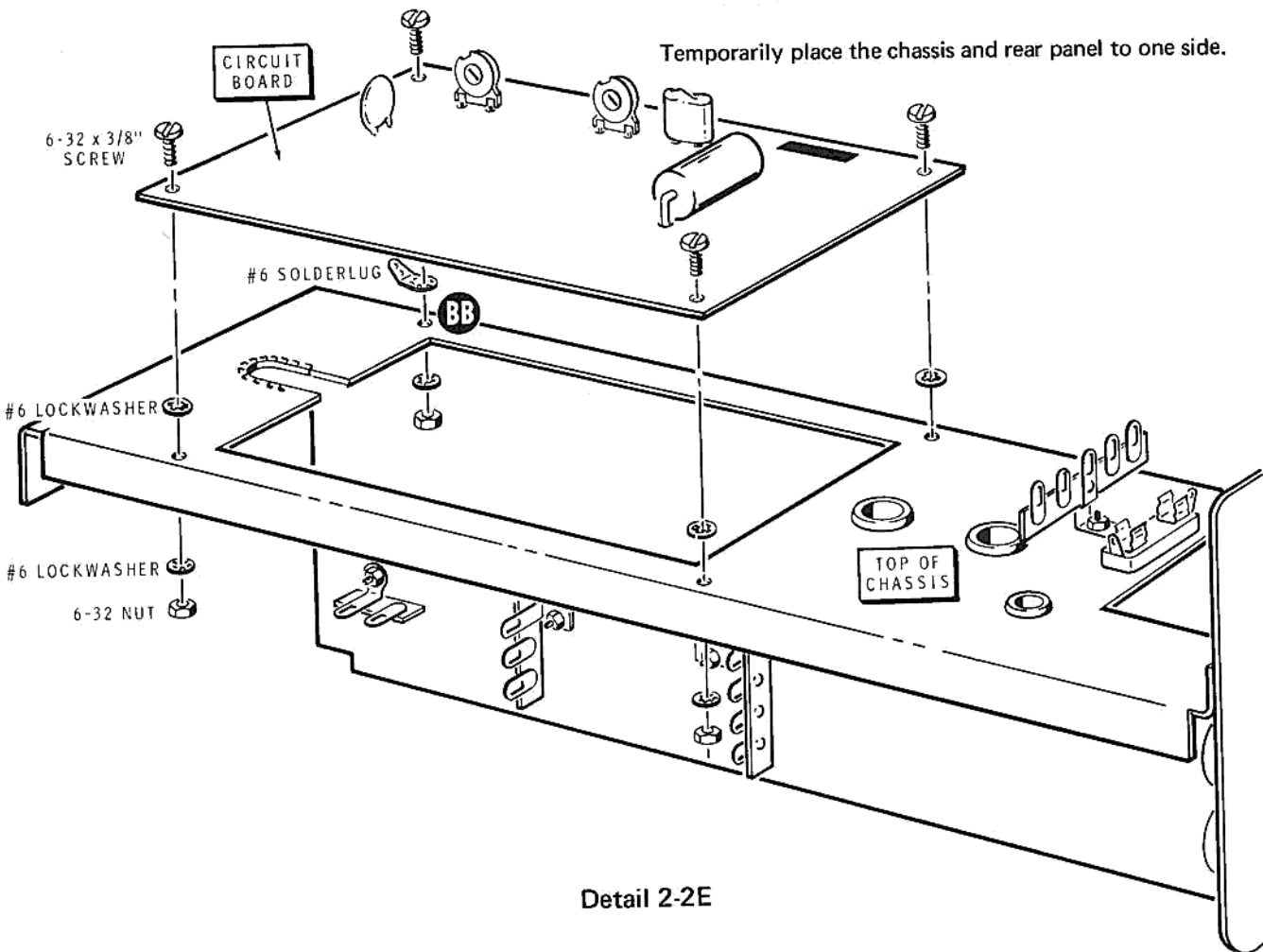
- () Refer to Detail 2-2D and insert the group of leads with the long brown wires up through grommet BC. Insert the other group of leads up through grommet BD. NOTE: A short length of tape or a rubber band around each group of leads will hold them together for easy insertion through the grommets.

- () Secure the power transformer to the chassis with 8-32 x 3/8" hardware as shown in the Detail.

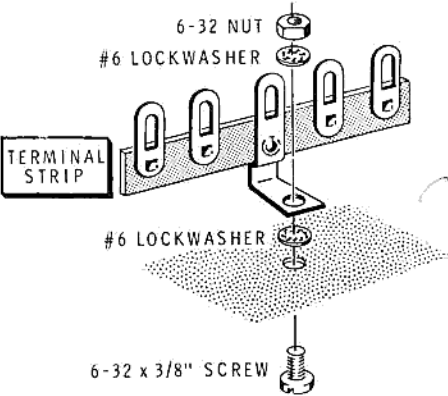
- () Refer to Detail 2-2E and mount the circuit board, component side up, on the top of the chassis. Position the circuit board as shown and secure it to the chassis with 6-32 x 3/8" hardware at the four indicated locations. NOTE: Be sure you use a #6 solder lug instead of a lockwasher at location BB.

NOTE: In the next four steps, position each terminal strip as shown in Pictorial 2-2.

- () Refer to Detail 2-2F and mount a large 5-lug terminal strip on the top of the chassis at BE with 6-32 x 3/8" hardware.



Detail 2-2E



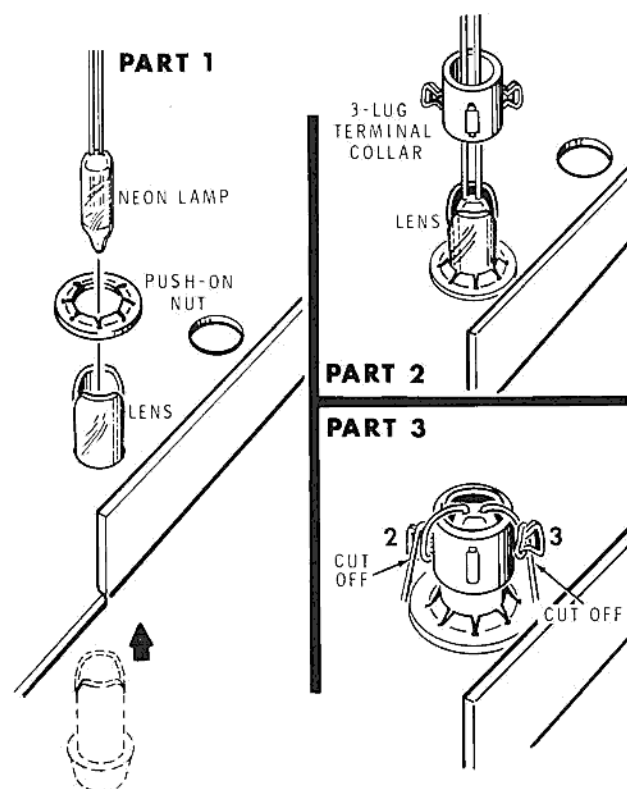
Detail 2-2F

- () Mount a 6-lug terminal strip on the inner side of the chassis at BH with 6-32 x 3/8" hardware.
- () Mount a large 5-lug terminal strip at BJ with 6-32 x 3/8" hardware.
- () Mount a 2-lug terminal strip at BK with 6-32 x 3/8" hardware.

731 0945 Thomas

FRONT PANEL PARTS MOUNTING

Refer to Pictorial 2-3 (fold-out from Page 23) for the following steps.



Detail 2-3A

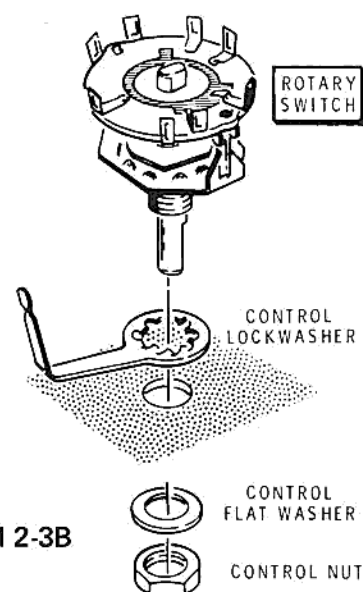
- () Refer to Part 1 of Detail 2-3A and from the front of the panel, insert a red lens into hole AH. Secure the lens in the panel with a push-on nut.

- () Insert a neon lamp in the red lens.

- () Position the terminal collar over the red lens as shown in Part 2 of Detail 2-3A; then press the collar down on the lens until it is even with the open end of the lens. Make sure the lugs on the collar are positioned as shown in the inset drawing on Pictorial 2-3.

- () Refer to Part 3 of the Detail and wrap one lamp lead two turns around lug 2 and the other lead two turns around lug 3. Cut off the excess lead lengths. CAUTION: Do not cross the lamp leads.

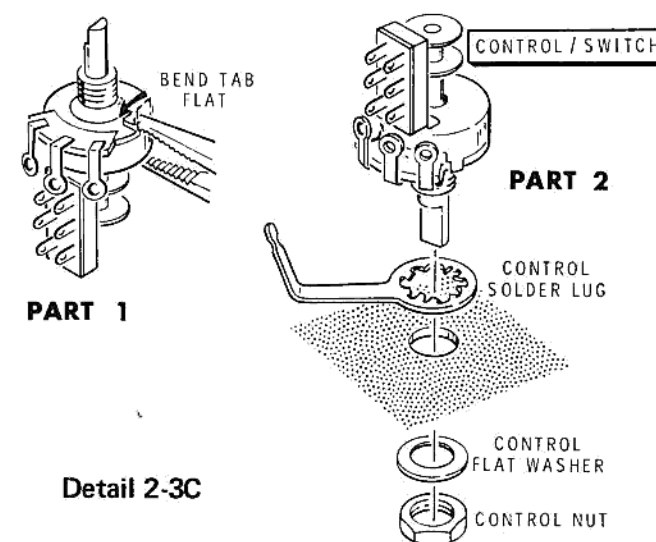
- () Locate the rotary switch (#63-642); then carefully turn the switch shaft to its full clockwise rotation. This will position the switch rotor as shown in the shaded area of Detail 2-3B.



Detail 2-3B

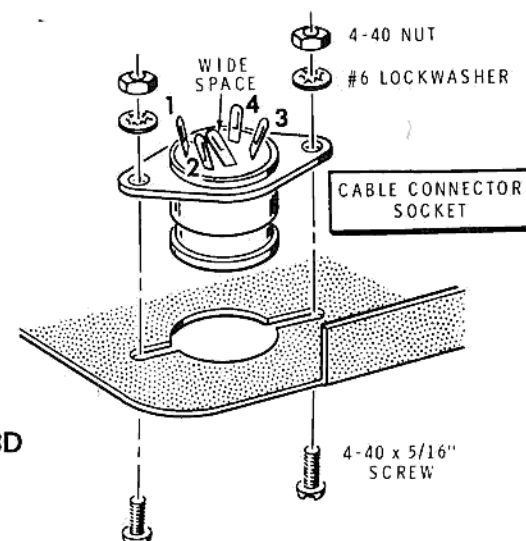
- () Refer to Detail 2-3B and mount the switch at AF with a control solder lug, control flat washer, and control nut. CAUTION: Position the switch and the control solder lugs as shown in the inset drawing on Pictorial 2-3.

- () Locate one 5000 Ω control/switch. Then refer to Part 1 of Detail 2-3C and bend the tab flat against the control.



Detail 2-3C

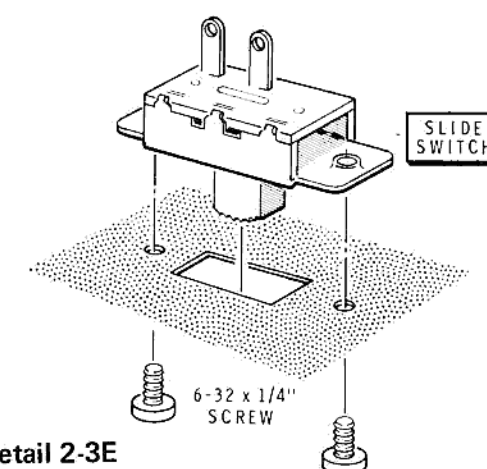
- () Refer to Part 2 of Detail 2-3C and mount this control/switch assembly at AJ with a control solder lug, a control flat washer, and a control nut. Position the control and control solder lug as shown in the Pictorial.



Detail 2-3D

- () Refer to Detail 2-3D and, with the wide space positioned as shown, mount a cable connector socket on the inside of the panel at AG. Use two 4-40 x 5/16" screws, two #6 lockwashers, and two 4-40 nuts. NOTE: These two 4-40 nuts are the same physical size as 6-32 nuts.

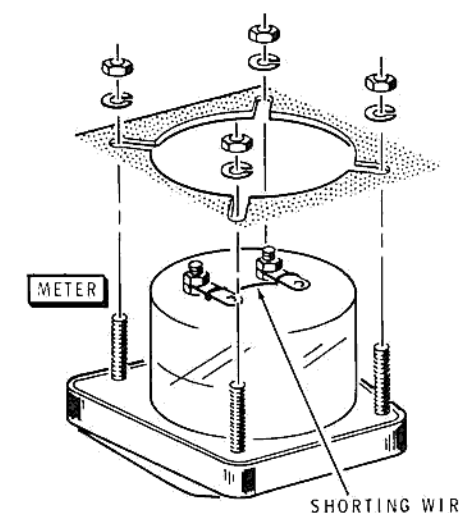
- () Bend lugs 1, 2, 3, and 4 outward as shown in the Detail.



Detail 2-3E

- () Refer to Detail 2-3E and mount a slide switch at AA with 6-32 x 1/4" screws. Position the switch lugs as shown in the Pictorial.

- () In a like manner, mount a slide switch at AC. Position the switch lugs as shown in the Pictorial.

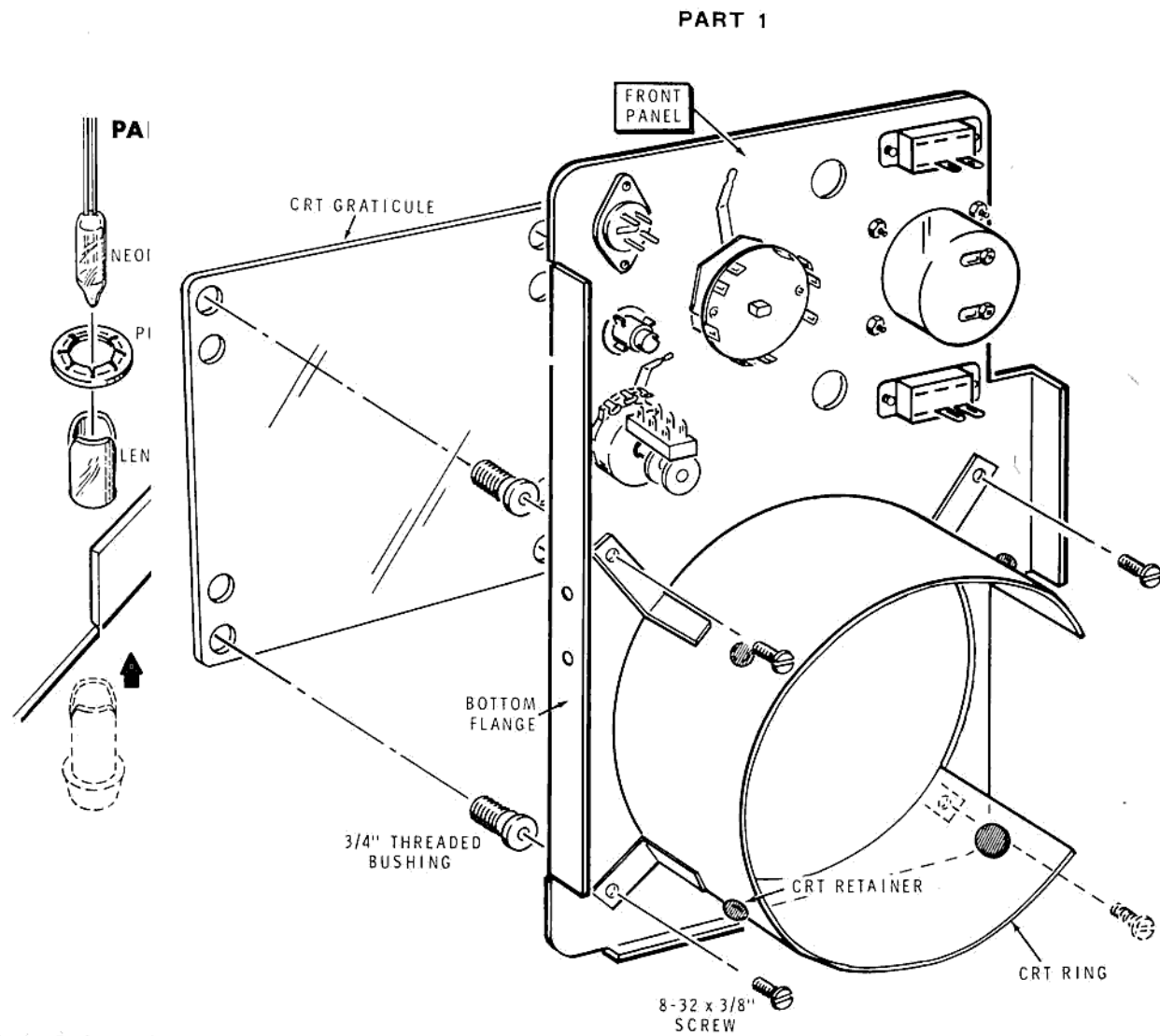


Detail 2-3F

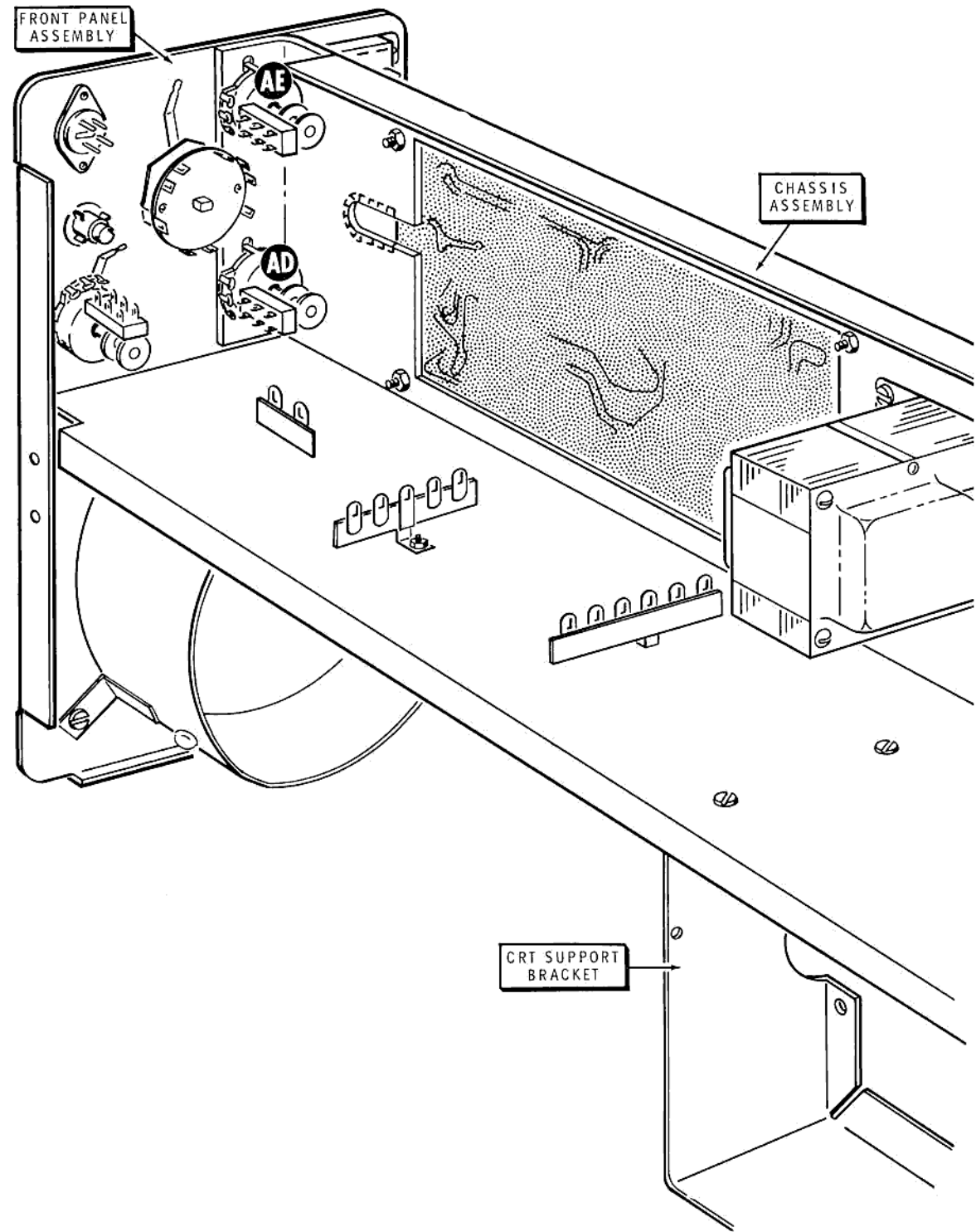
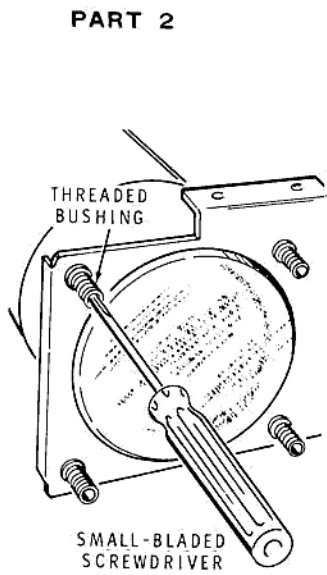
- () Refer to Detail 2-3F and mount the meter at AB. Use the lockwashers and nuts supplied with the meter. Do not overtighten the nuts. NOTE: If you wish, cut the top of the meter carton off and tape it over the meter. It will prevent the meter face from being scratched.

FRONT PAN

Refer to Pict
following steps

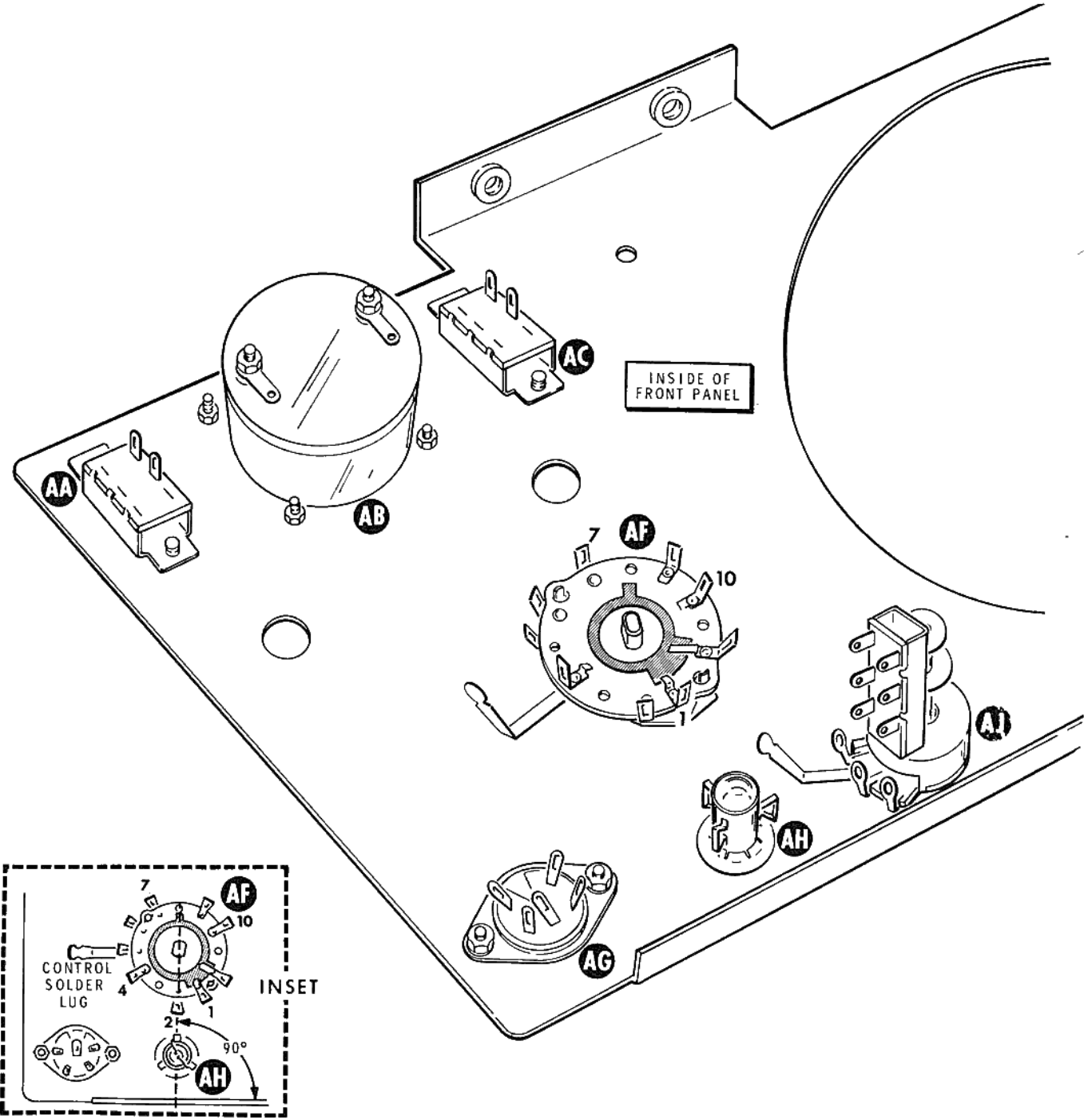


Detail 2-5B



PICTORIAL 2-5

- () Refer to I
the panel,
lens in the
- () Insert a ne



PICTORIAL 2-3

will be used to

and place the
old the graticule
the four 8-32 x

and remove the
ff the threaded
and slightly tilt
will allow free

d for later.

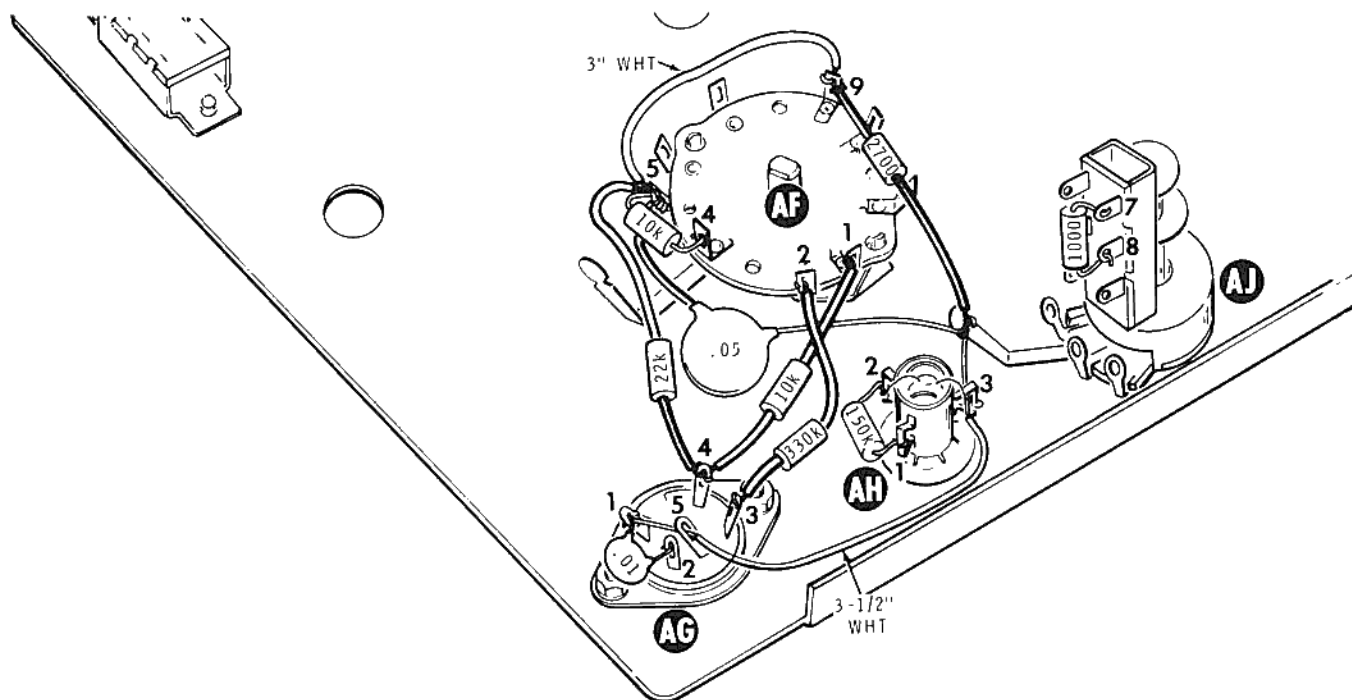
panel assembly
erring to Detail
1 at AE. Use a
and tighten the



control/switch

trol/switch is in
control nuts to

6"



PICTORIAL 2-4

FRONT PANEL PRELIMINARY WIRING

Refer to Pictorial 2-4 for the following steps.

- () Connect a 150 kΩ (brown-green-yellow) resistor between lug 1 (NS) and lug 2 (S-2) of panel lamp assembly AH. NOTE: Be sure you solder the lamp lead wrapped around lug 2.

- () Connect a 10 kΩ (brown-black-orange) resistor between lugs 4 (S-1) and 5 (NS) of switch AF.

NOTE: Use wire of the color specified when wire is called for in a step. Cut the wire to the proper length and remove 1/4" of insulation from each end unless directed otherwise in a step. Position each wire as shown.

- () Connect a 3" white wire between lugs 5 (NS) and 9 (NS) of switch AF.

- () Connect one lead of a .05 μF disc capacitor to lug 5 of switch AF (NS). Wrap the other lead around the solder lug of control/switch AJ (NS).

- () Place 3/4" lengths of sleeving on both leads of a 2700 Ω (red-violet-red) resistor. Wrap this lead around the control solder lug of control/switch AJ (NS). Connect the other lead to lug 9 of switch AF (S-2).

- () Place a 3/4" length of sleeving on one lead of a 22 kΩ (red-red-orange) resistor. Connect this lead to lug 4 of socket AG (NS). Connect the other lead to lug 5 of switch AF (S-4).

- () Place a 1/2" length of sleeving on each lead of a 10 kΩ (brown-black-orange) resistor. Connect one lead to lug 1 of switch AF (S-1) and the other lead to lug 4 of socket AG (S-2).

- () Place a 1/2" length of sleeving on each lead of a 330 kΩ (orange-orange-yellow) resistor. Connect one lead to lug 2 of switch AF (S-1) and the other lead to lug 3 of socket AG (S-1).

- () Remove 1" of insulation from one end and 3/8" of insulation from the other end of a 3-1/2" white wire.

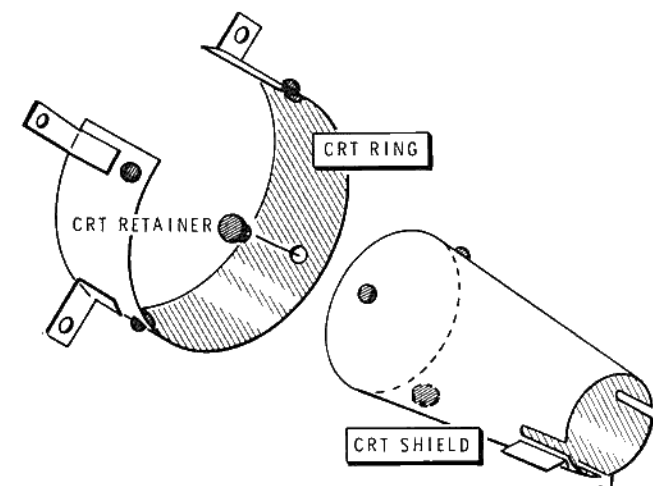
NOTE: When a wire passes through a connection and then goes to another point as in the next step, it will count as two wires in the solder instructions (S-2), one entering and one leaving the connection. Be sure these "through wires" are properly soldered to the connection.

- () Insert the longer bare end of the 3-1/2" white wire through lug 3 of panel lamp assembly AH (S-3) to the solder lug of control/switch AJ (NS). Be sure you solder the lamp lead that is wrapped around lug 3.

- () Insert the other end of the white wire through lug 5 (S-2) to lug 1 (NS) of socket AG.

- () Cut both leads of a .01 μF disc capacitor to 1/2". Then connect the capacitor between lugs 2 (NS) and 1 (NS) of socket AG.

- () Connect a 1000 Ω (brown-black-red) resistor between lugs 8 (S-1) and 7 (NS) of control/switch AJ.



Detail 2-5A

FRONT PANEL ASSEMBLY MOUNTING

Refer to Pictorial 2-5 (fold-out from Page 24) for the following steps.

- () Locate the CRT ring, the CRT shield, and seven CRT retainers.

- () Refer to Detail 2-5A and install four CRT retainers in the CRT ring from the inside.

- () In the same way, install three CRT retainers in the CRT shield. Then set the shield aside until it is called for later.

- () Refer to Part 1 of Detail 2-5B and loosely mount the CRT ring to the front panel with 8-32 x 3/8" screws and 3/4" threaded bushings at the four locations shown. Make sure the open side of the ring is positioned as shown.

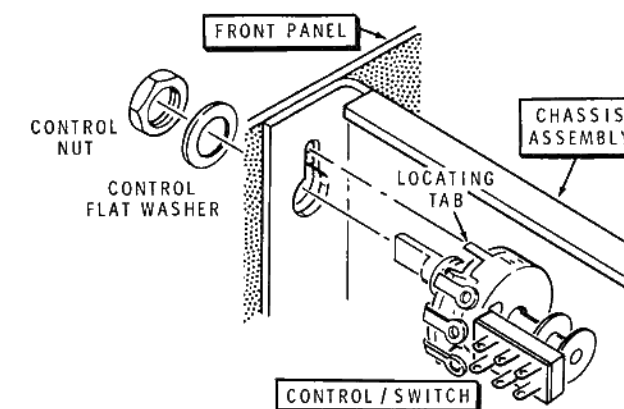
NOTE: In the following steps, the graticule will be used to properly position the threaded bushings.

- () Refer again to Part 1 of Detail 2-5B and place the graticule on the threaded bushings. Hold the graticule against the panel and securely tighten the four 8-32 x 3/8" screws.

- () Refer to Part 2 of Detail 2-5B and remove the graticule. If it will not freely slide off the threaded bushings, use a small-blade screwdriver and slightly tilt the bushings in a direction that will allow free movement of the graticule.

- () Place the graticule aside until it is called for later.

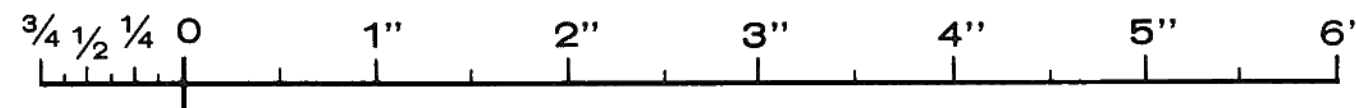
- () Position the chassis assembly and front panel assembly as shown in the Pictorial. Then referring to Detail 2-5C, mount a 5000 Ω control/switch at AE. Use a control flat washer and control nut and tighten the nut only finger tight.

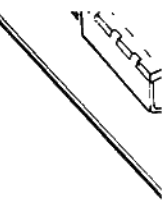


Detail 2-5C

- () In the same manner, mount a 5000 Ω control/switch at AD.

- () Be sure the locating tab on each control/switch is in the slot in the chassis. Then tighten the control nuts to secure the panel to the chassis.





FRONT PANEL

Refer to Pictorial

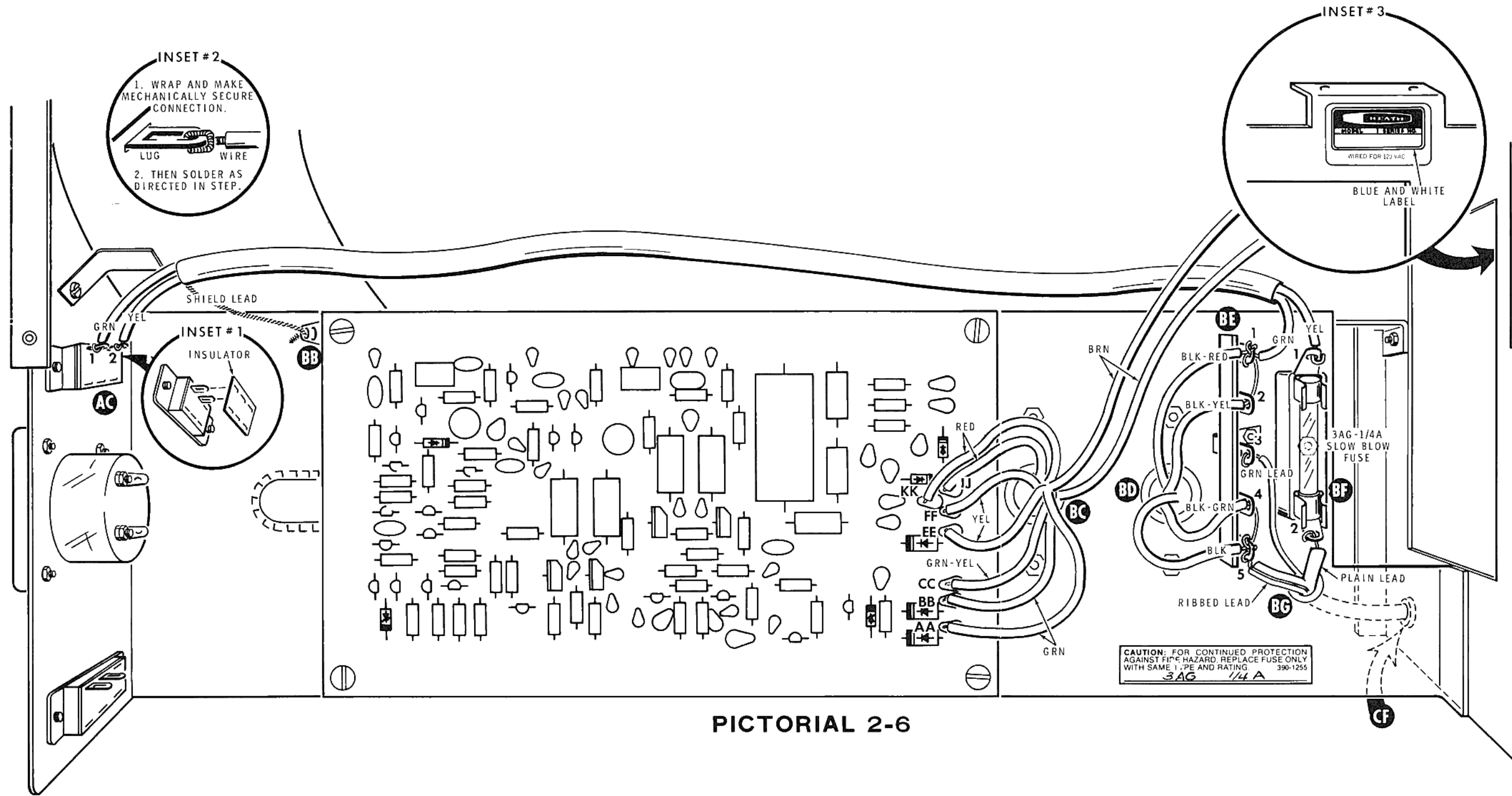
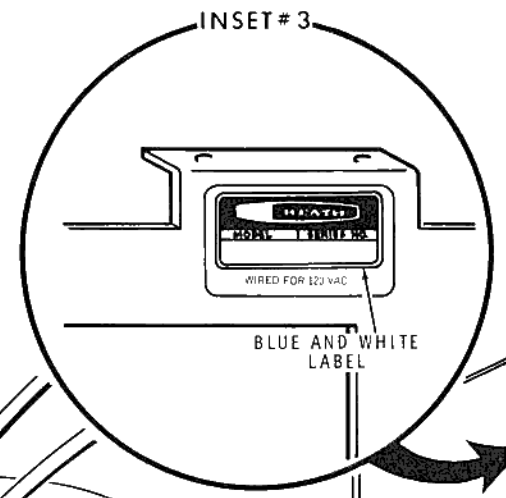
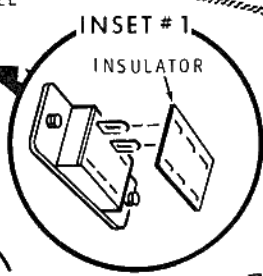
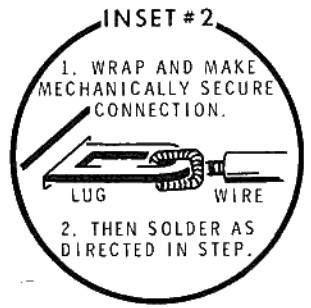
- () Connect between assembly wrapped
- () Connect between

NOTE: Use wire for in a step. Cut 1/4" of insulation in a step. Position

- () Connect (NS) of switch

- () Connect of switch solder lug

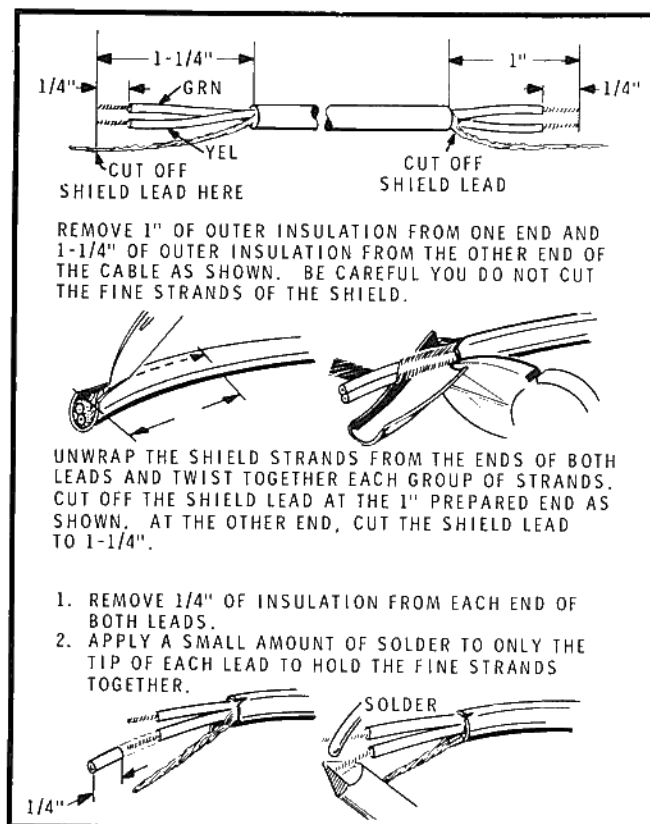
- () Place 3/4 2700 Ω around terminal (NS). Connect (S-2).



PICTORIAL 2-6

CHASSIS TOP PRELIMINARY WIRING

Refer to Pictorial 2-6 for the following steps.



Detail 2-6A

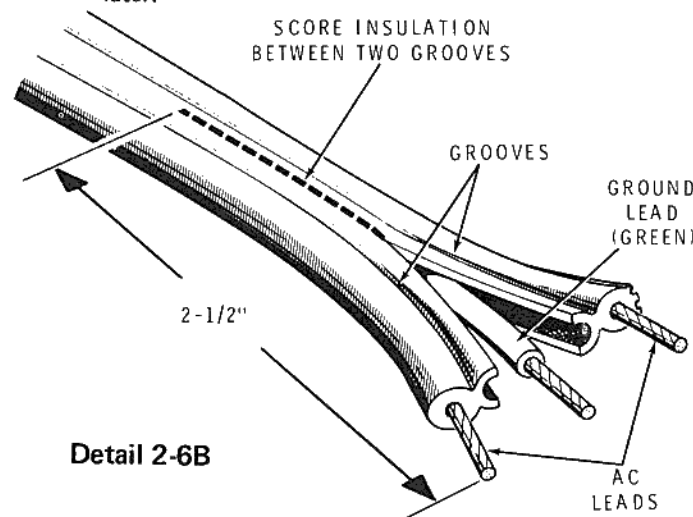
- () Refer to Detail 2-6A and prepare a 15" length of 2-conductor shielded cable as shown.
- () Connect the shield lead to solder lug BB (NS).
- () Refer to inset drawing #1 on the Pictorial and place a fiber insulator on switch AC as shown. NOTE: If the lugs are in the center of the switch, discard the insulator; it will not fit over the lugs.

NOTE: When you connect a wire in the following steps, be sure you make a mechanically secure connection before soldering. See inset drawing #2 on the Pictorial.

- () Connect the yellow wire of the shielded cable to lug 2 (S-1) and the green wire to lug 1 (S-1) of switch AC.
- () At the other end of the shielded cable, connect the yellow wire to lug 1 of fuse block BF (S-1). Connect the green wire to lug 1 of terminal strip BE (NS).

In the following steps, connect the wires coming from grommet BC to the circuit board. Insert the bare end of each wire through its circuit board hole as far as it will go. Then solder the wire to the foil and cut off the excess wire lengths.

- () Either red in hole KK (S-1).
- () Other red in hole JJ (S-1).
- () Either yellow in hole FF (S-1).
- () Other yellow in hole EE (S-1).
- () Green-yellow in hole CC (S-1).
- () Either green in hole BB (S-1).
- () Other green in hole AA (S-1).
- () Route the two brown wires over toward the CRT shield and out of the way. They will be connected later.



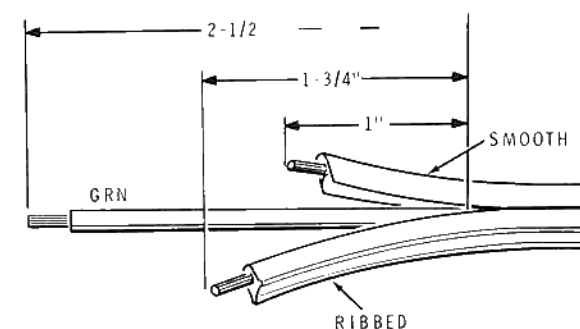
Detail 2-6B

LINE CORD PREPARATION

- () Refer to Detail 2-6B and split the outer insulation of the line cord in the following manner, as shown, so you do not cut into the protective insulation for the AC leads.
- 1. Use a knife point to score a line, as shown, BETWEEN the two grooves.

- 2. Turn the cord over and repeat step 1.
- 3. Grasp the lead ends by the insulation and pull the leads apart. The line cord will separate on the scored lines.

- () Refer to Detail 2-6C and prepare the end of the 3-conductor line cord as shown. Remove 3/8" of insulation from the end of each lead.

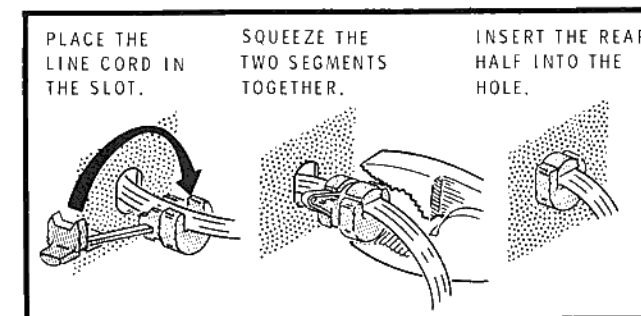


Detail 2-6C

- () Insert the prepared end of the cord through hole CF in the rear panel; then route it up through grommet BG in the chassis as shown by the dotted line in Pictorial 2-6.

Refer to Pictorial 2-6 and connect the line cord leads as directed in the following steps. Be sure you make mechanically secure connections before soldering.

- () Connect the smooth lead to lug 2 of fuse block BF (S-1).
- () Connect the green lead to lug 3 of terminal strip BE (S-1).
- () Connect the ribbed lead to lug 5 of terminal strip BE (NS).



Detail 2-6D

- () Refer to Detail 2-6D and secure the line cord in hole CF in the rear panel. Be sure you leave some slack in the cord between hole CF and grommet BG.

- () Remove the backing paper from the fuse label. Then press the label on the chassis as shown in the Pictorial.

POWER TRANSFORMER PRIMARY WIRING

NOTE: The primary leads of the power transformer can be connected for operation from a 120 volt or 240 volt 50/60 Hz power source. In the U.S.A., 120 volts is most often used, while in other countries 240 volts is more common. Use only the instructions that agree with the line voltage in your area. For 240 volt wiring, see Page 28 and Detail 2-6E.

120 Volt Wiring

Refer to Pictorial 2-6 for the following steps. Connect the leads coming from grommet BD as directed in the following steps. Be sure to make mechanically secure connections.

- () Remove an additional 3/8" of insulation from the black-yellow lead.
- () Insert the bare end of the black-yellow lead through lug 2 (S-2) to lug 1 (NS) of terminal strip BE.
- () Connect the black-red lead to lug 1 of terminal strip BE (S-3).
- () Remove an additional 3/8" of insulation from the black-green lead.
- () Insert the bare end of the black-green lead through lug 4 (S-2) to lug 5 (NS) of terminal strip BE.
- () Connect the black lead to lug 5 of terminal strip BE (S-3).
- () Snap the 1/4-ampere slow-blow fuse supplied with this kit into fuse block BF. Mark the type and rating of the fuse on the fuse label.

NOTE: In the following step you will install the identification label. Be sure to refer to the numbers on this label in any communications you have with Heath Company about this kit.

- () Carefully peel the backing paper from the blue and white identification label. Then press the label onto the rear panel as shown in inset drawing #3 on Pictorial 2-6. NOTE: Be sure you position the label over "Wired For 240 VAC". The "Wired For 120 VAC" should remain exposed.



Proceed to "Wiring Harness Installation" on Page 29.

240 Volt Wiring

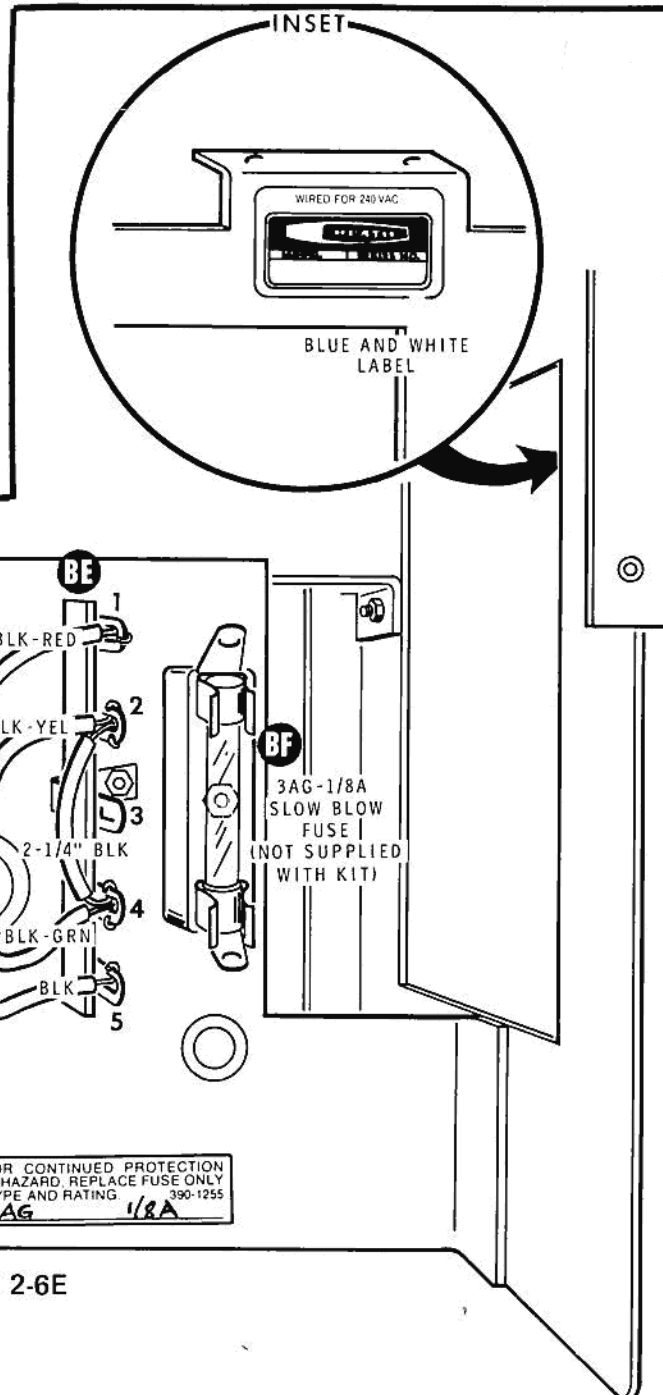
Refer to Detail 2-6E and connect the leads coming from grommet BD as directed in the following steps. Be sure to make mechanically secure connections.

- () Connect the black-red lead to lug 1 of terminal strip BE (S-2).
- () Connect the black-yellow lead to lug 2 of terminal strip BE (NS).
- () Connect the black-green lead to lug 4 of terminal strip BE (NS).
- () Cut a 2-1/4" length of wire from the black transformer lead. Then remove 1/2" of insulation from the cut off end of the 2-1/4" length of black wire.
- () Connect the 2-1/4" black wire between lugs 2 (S-2) and 4 (S-2) of terminal strip BE. CAUTION: Position the wire away from lug 3 of terminal strip BE.
- () Remove 1/2" of insulation from the end of the black lead coming from grommet BD. Then connect this black lead to lug 5 of terminal strip BE (S-2).
- () Snap a 1/8-ampere slow-blow fuse into fuse block BF. NOTE: Procure this 1/8-ampere fuse from a local store

as it is not supplied with the kit. Mark the type and rating of the fuse on the fuse label.

NOTE: In the following step you will install the identification label. Be sure to refer to the numbers on this label in any communications you have with Heath Company about this kit.

- () Carefully peel the backing paper from the blue and white identification label. Then press the label onto the rear panel as shown in the inset drawing on Detail 2-6D. NOTE: Be sure you position the label over "Wired For 120 VAC." The "Wired For 240 VAC" should remain exposed.



Detail 2-6E

WIRING HARNESS INSTALLATION

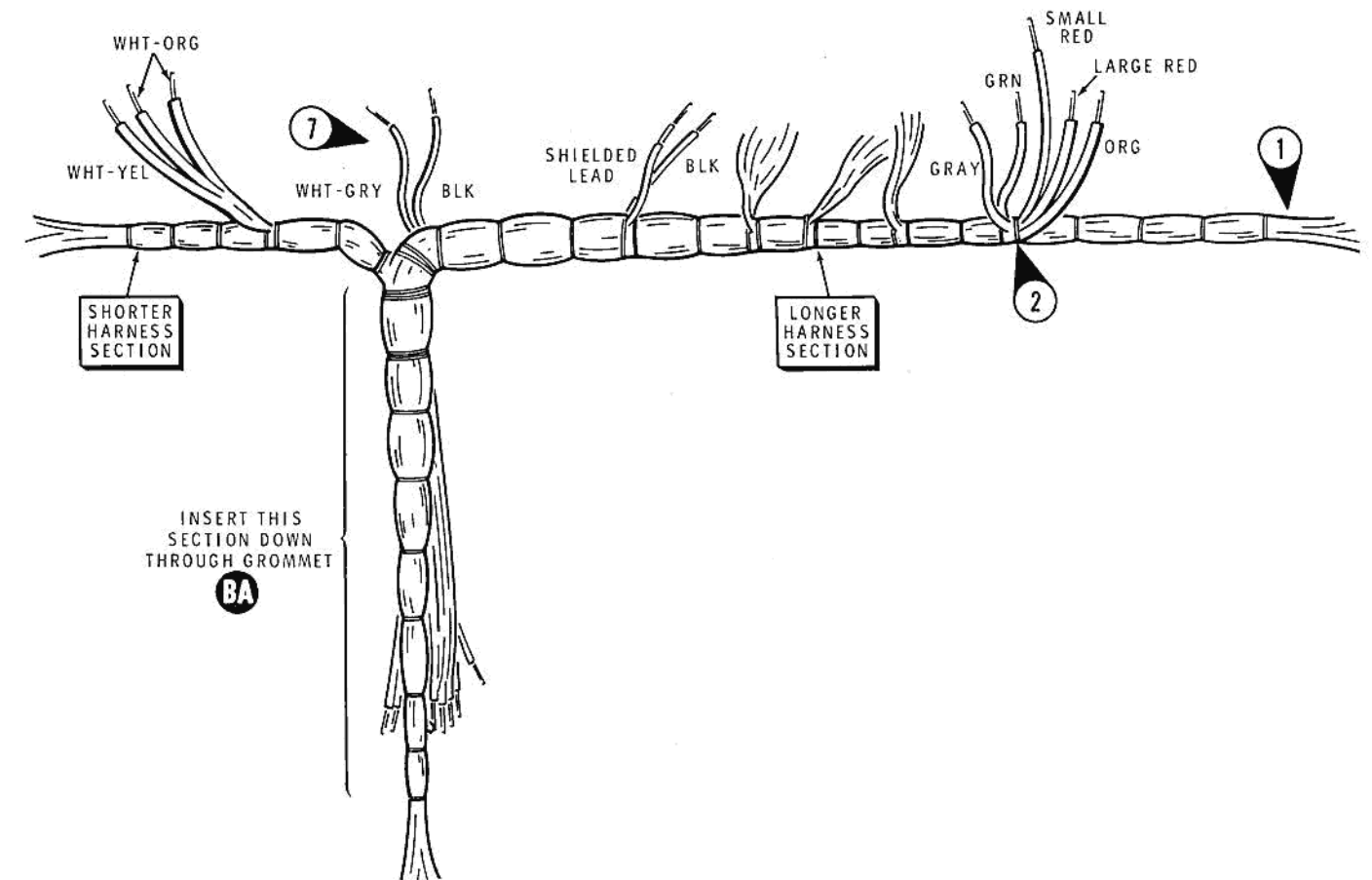
Refer to Pictorial 2-7 (fold-out from Page 29) for the following steps.

- () Refer to Detail 2-7A and form the wiring harness as shown.
- () From the top of the chassis, carefully insert the indicated section of the wiring harness down through grommet BA.

() Refer to Part B of Pictorial 2-7 and position the section of the harness coming from grommet BA out of the way and toward the rear of the chassis.

() Refer to Part A of Pictorial 2-7 and position the longer harness section along the top of the chassis next to the CRT shield. Position all of the wires from each breakout as shown, with the wires coming from BO#1 down toward the CRT mounting bracket at the rear of the chassis.

() Position the shorter harness section along the edge of the circuit board as shown.

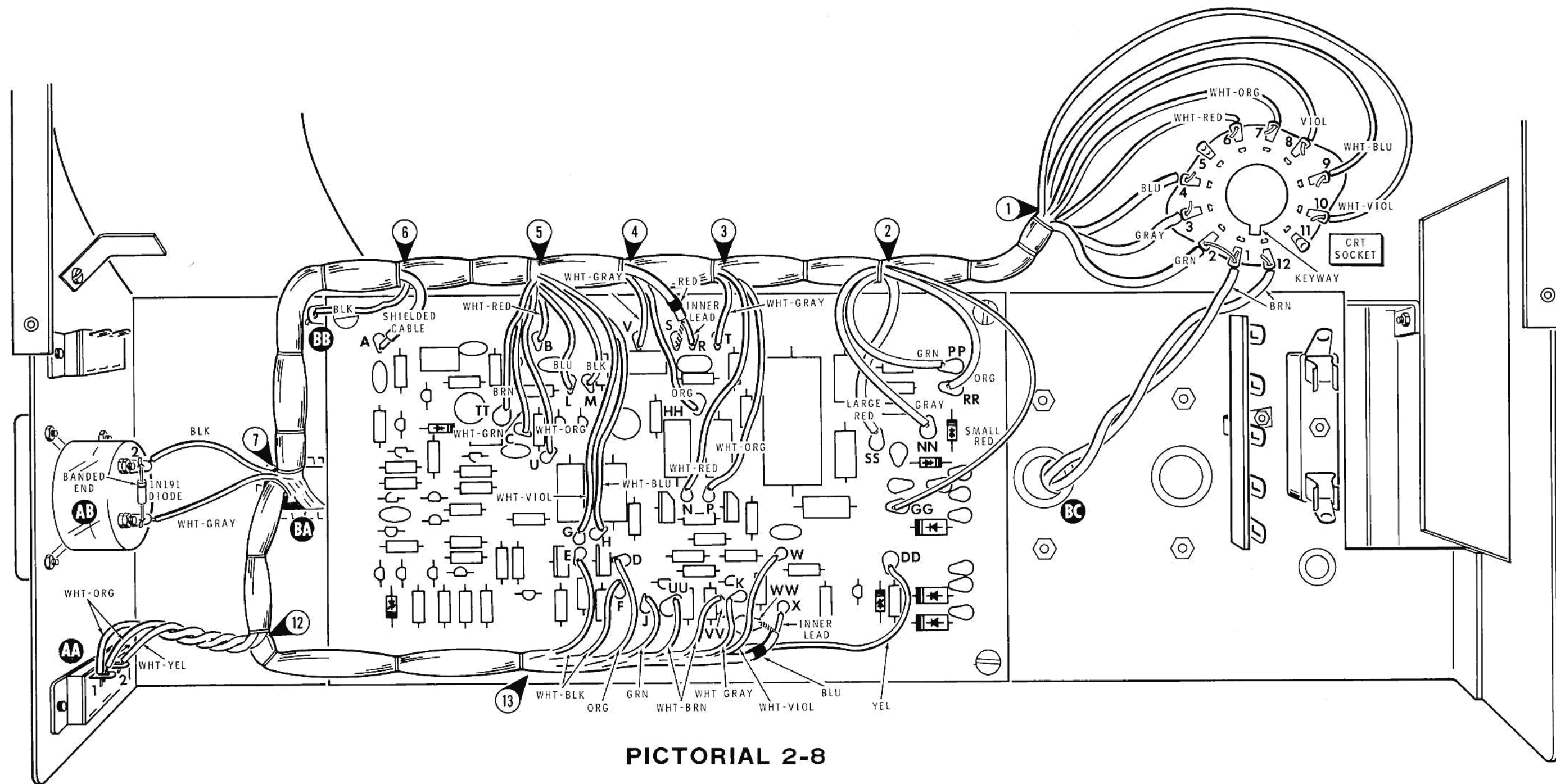


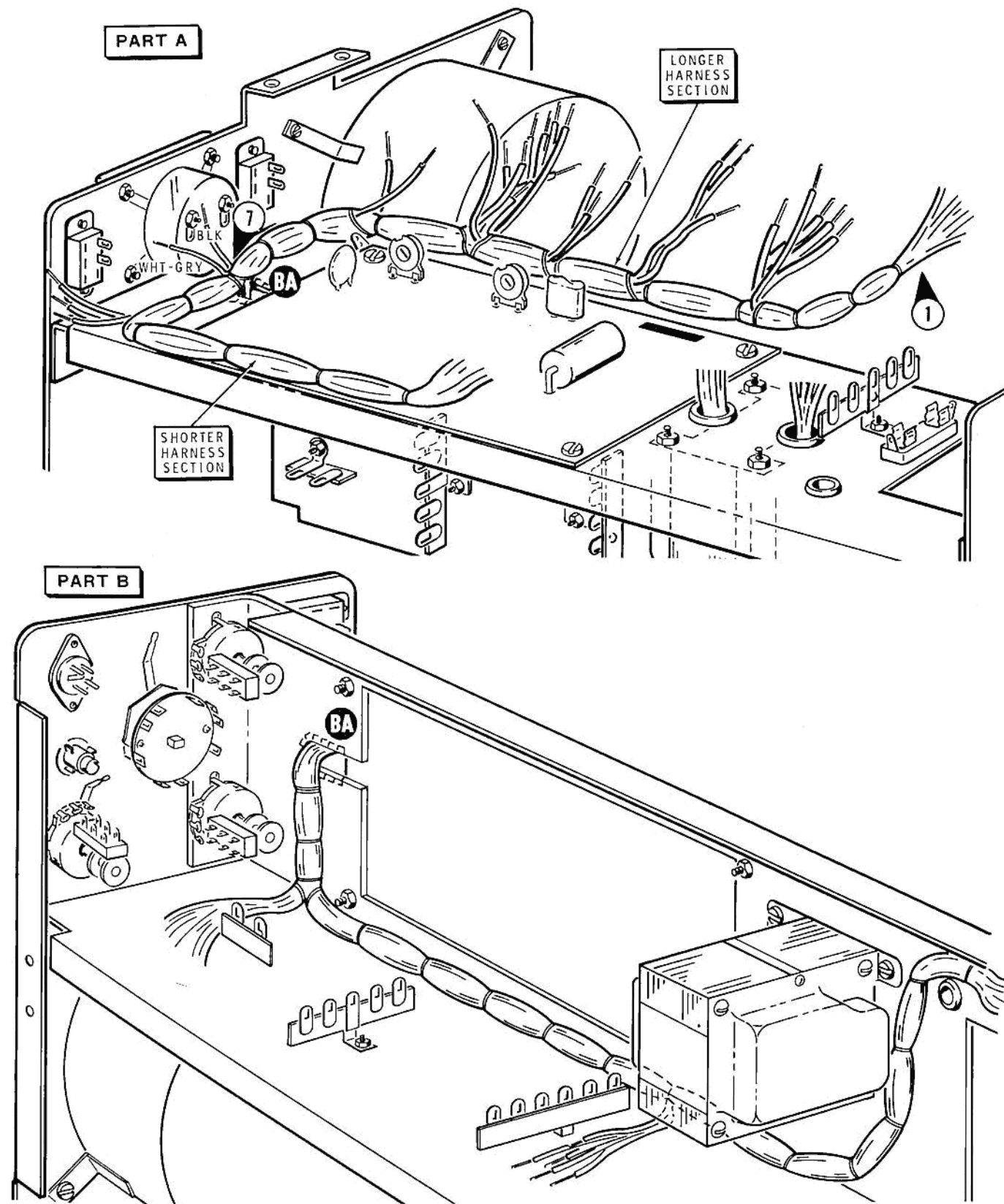
Detail 2-7A

240 Volt W

Refer to De-
grommet BD
make mechan

- () Connect BE (S-2)
 - () Connect strip BE
 - () Connect BE (NS)
 - () Cut a transform from the wire.
 - () Connect and 4 (S) the wire
 - () Remove lead core black lead
 - () Snap a 1
- NOTE: F





5 and lug 11

O#12. Then

circuit board

le to hole X

PICTORIAL 2-7



CHASSIS TOP FINAL WIRING

Refer to Pictorial 2-8 for the following steps.

- () Remove the shorting wire from between the meter binding posts and bend the lugs out as shown.

- () Connect the banded end of a 1N191 (brown-white-brown) diode (#56-26) to lug 2 of meter AB (NS). Connect the other lead of the diode to lug 1 of meter AB (NS).

Connect the wires from BO#7 to meter AB as follows:

- () Black to lug 2 (S-2).
- () White-gray to lug 1 (S-2).

Connect the wires coming from BO#6 as follows:

- () Black wire to solder lug BB (S-2).
- () Insert the inner lead of the shielded cable into circuit board hole A. Then solder the wire to the foil and cut off the excess wire length.

NOTE: When you connect the wiring harness wires to the circuit board, insert each wire into its circuit board hole as far as it will go. Then solder the wire to the foil and cut off the excess wire lengths.

Connect the wires coming from BO#5 to the circuit board as directed in the following steps.

- () White-red to hole B (S-1).
- () Brown to hole TT (S-1).

- () White-green to hole C (S-1).

- () White-orange to hole U (S-1).

- () Blue to hole L (S-1).

- () Black to hole M (S-1).

- () White-blue to hole H (S-1).

- () White-violet to hole G (S-1).

Connect the wires coming from BO#4 to the circuit board as follows:

- () White-gray to hole V (S-1).
- () Orange to hole HH (S-1).

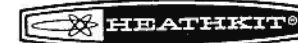
- () Insert the inner lead of the red marked shielded cable in hole R (S-1) and the shield lead in hole S (S-1).

Connect the wires coming from BO#3 to the circuit board as follows:

- () White-gray to hole T (S-1).
- () White-orange to hole P (S-1).
- () White red to hole N (S-1).

Connect the wires coming from BO#2 to the circuit board as follows:

- () Large red to hole SS (S-1).
- () Green to hole PP (S-1).



- () Orange to hole RR (S-1).

- () Gray to hole NN (S-1).

- () Small red to hole GG (S-1).

Connect the two brown wires coming from grommet BC and the green harness wire coming from BO#1 to the CRT socket as directed in the following steps.

- () Loosely twist together the brown wires coming from grommet BC.

- () Connect either brown wire to lug 12 (S-1) and the other brown wire to lug 1 (NS) of the CRT socket.

- () Remove an additional 1/4" of insulation from the end of the green wire coming from BO#1 of the wiring harness.

- () Insert the end of the green wire through lug 2 (S-2) to lug 1 (S-2) of the CRT socket.

Connect the remaining wires coming from BO#1 to the CRT socket as follows:

- () Gray to lug 3 (S-1).
- () Blue to lug 4 (S-1).
- () White-red to lug 6 (S-1).
- () White-orange to lug 7 (S-1).
- () Violet to lug 8 (S-1).
- () White-blue to lug 9 (S-1).

- () White-violet to lug 10 (S-1).

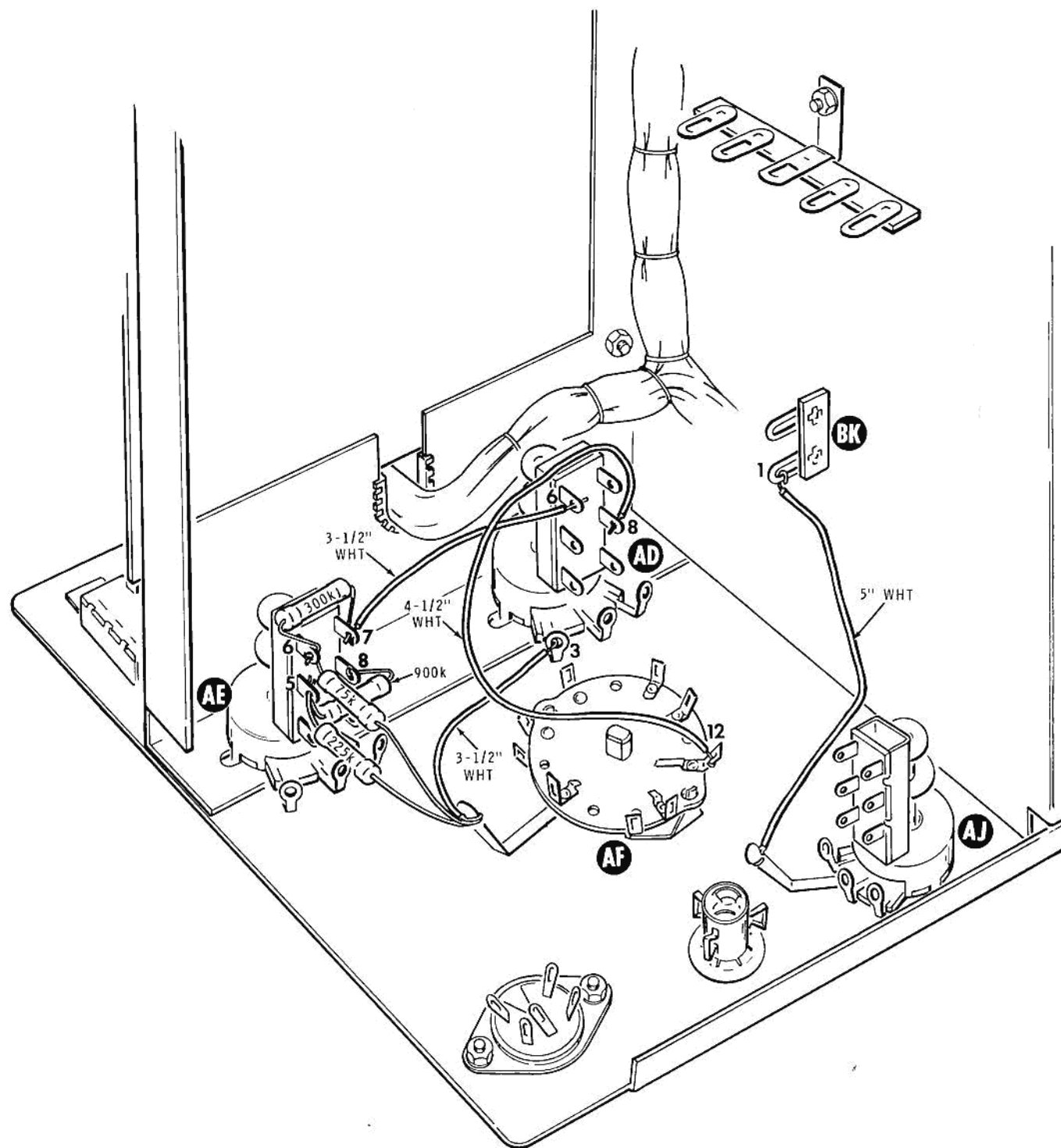
NOTE: There should be no connections to lug 5 and lug 11 of the CRT socket.

Twist together the three wires coming from BO#12. Then connect the wires to switch AA as follows:

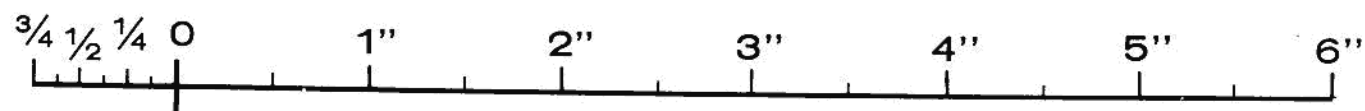
- () White-yellow to lug 2 (S-1).
- () Both white-orange to lug 1 (S-2).

Connect the wires coming from BO#13 to the circuit board as follows:

- () Either white-black to hole E (S-1).
- () Other white-black to hole F (S-1).
- () Orange to hole D (S-1).
- () Green to hole J (S-1).
- () Either white-brown to hole UU (S-1).
- () Other white-brown to hole VV (S-1).
- () White-gray to hole K (S-1).
- () Inner lead of blue marked shielded cable to hole X (S-1) and shield lead to hole WW (S-1).
- () White-violet to hole W (S-1).
- () Yellow to hole DD (S-1).



PICTORIAL 2-9



CHASSIS BOTTOM WIRING

Front Panel

Refer to Pictorial 2-9 for the following steps.

- () Connect a 3-1/2" white wire to lug 3 of control/switch AD (S-1). Wrap the other end of the wire around the control solder lug of switch AF (NS).
- () Connect a 4-1/2" white wire from lug 8 of control/switch AD (S-1) to lug 12 of switch AF (S-1).
- () Connect a 5" white wire from the control solder lug of control/switch AJ (S-4) to lug 1 of terminal strip BK (S-1). Position this white wire flat against the front panel and the chassis.
- () Cut both leads of a 900 k Ω (white-black-black-orange), 1% precision resistor to 5/8".
- () Connect the 900 k Ω resistor between lugs 8 (S-1) and 5 (NS) of control/switch AE.
- () Connect a 225 k Ω (red-red-green-orange), 1% precision resistor from lug 5 of control/switch AE (S-2) to the control solder lug of switch AF (NS).
- () Cut both leads of a 300 k Ω (orange-black-black-orange), 1% precision resistor to 5/8".
- () Connect the 300 k Ω resistor between lugs 6 (NS) and 7 (NS) of control/switch AE.
- () Connect a 3-1/2" white wire from lug 7 of control/switch AE (S-2) to lug 6 of control/switch AD (NS).
- () Connect a 75 k Ω (violet-green-black-red), 1% precision resistor from the control solder lug of switch AF (S-3) to lug 6 of switch AE (NS).

Refer to Pictorial 2-10 (fold-out from this page) for the following steps:

Connect the wires coming from wiring harness BO#8 as follows:

- () Either white-black to lug 2 (S-1) and the other white-black wire to lug 3 (S-1) of control/switch AE.

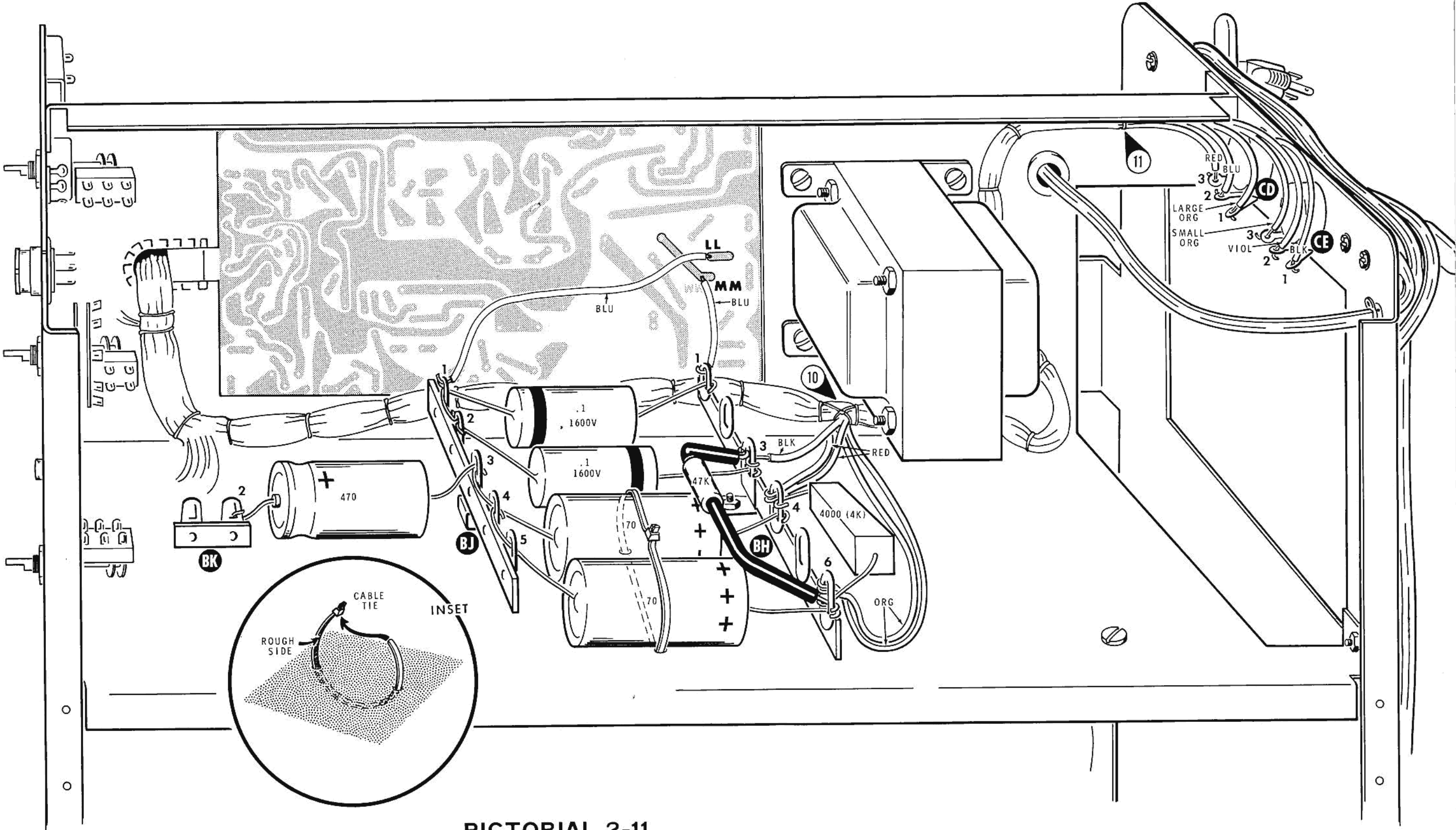
- () White-yellow to lug 6 of control/switch AE (S-3).

Connect the wires and shielded cables coming from BO#9 as follows:

- () Brown to lug 1 of control/switch AD (S-1).
- () Orange to lug 2 of control/switch AD (S-1).
- () White-red to lug 7 of control/switch AD (S-1).
- () White-orange to lug 6 of control/switch AD (S-2).
- () White-green to lug 5 of control switch AD (S-1).
- () Connect the blue marked shielded cable to lug 10 of switch AF (S-1).
- () Connect the red marked shielded cable to lug 6 of switch AF (S-1).
- () Connect the inner lead of the unmarked shielded cable to lug 2 (S-2) and the shield lead to lug 1 (S-3) of socket AG.

Connect the remaining wires coming from BO#9 as directed in the following steps. Position each wire down out of the way after it is soldered.

- () Red to lug 1 of panel lamp assembly AH (S-2).
- () Blue to lug 3 of control/switch AJ (S-1).
- () Green to lug 2 of control/switch AJ (S-1).
- () Black to lug 1 of control/switch AJ (S-1).
- () Either white-brown to lug 9 (S-1) and the other white-brown to lug 7 (S-2) of control/switch AJ.
- () Yellow to lug 2 of terminal strip BK (NS).
- () White-violet to lug 7 of switch AF (S-1).



PICTORIAL 2-11

Main Chassis and Rear Panel

Refer to Pictorial 2-11 for the following steps.

Connect the wires coming from BO#10 to terminal strip BH as follows:

- () Black to lug 3 (NS).
- () Both red to lug 4 (NS).
- () Both orange to lug 6 (NS).

Connect the wires coming from BO#11 to the controls on the rear panel as follows:

- () Red to lug 3 of control CD (S-1).
- () Blue to lug 2 of control CD (S-1).
- () Large orange to lug 1 of control CD (S-1).
- () Small orange to lug 3 of control CE (S-1).
- () Violet to lug 2 of control CE (S-1).
- () Black to lug 1 of control CE (S-1).

NOTE: In the following steps, be sure you mount each capacitor so its marked end is positioned as shown in Pictorial 2-11.

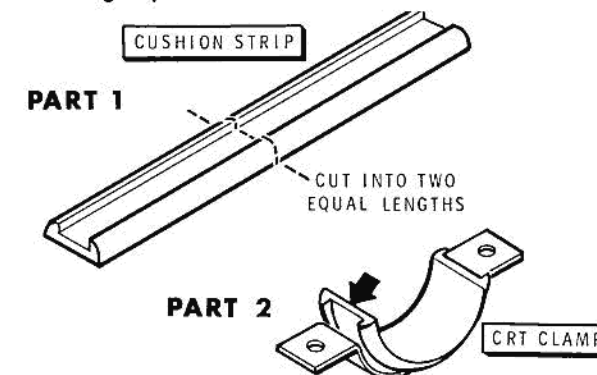
- () Connect the positive (+) lead of a 470 μ F electrolytic capacitor to lug 2 of terminal strip BK (S-2). Connect the other lead of the capacitor to lug 3 of terminal strip BJ (NS).
- () Insert the lead at the banded end of a .1 μ F, 1600 V capacitor through lug 1 (NS) to lug 2 (NS) of terminal strip BJ.
- () Connect the other lead of the capacitor to lug 1 of terminal strip BH (NS).

- () Connect the banded end of a .1 μ F, 1600 V capacitor to lug 3 of terminal strip BH (NS). Connect the other lead of the capacitor to lug 2 of terminal strip BJ (S-2).
- () Connect the positive (+) lead of a 70 μ F electrolytic capacitor to lug 4 of terminal strip BH (NS). Insert the other lead through lug 4 (NS) to lug 3 (S-2) of terminal strip BJ.
- () Connect the positive (+) lead of a 70 μ F electrolytic capacitor to lug 6 of terminal strip BH (NS). Insert the other lead through lug 5 (S-2) to lug 4 (S-3) of terminal strip BJ.
- () Refer to the inset drawing, route the cable tie through the chassis holes and around the two 70 μ F capacitors, and secure the cable tie as shown.
- () Connect a 4000 Ω (4 k Ω), 7-watt resistor between lug 6 (NS) and lug 4 (S-4) of terminal strip BH. Position the resistor at least 1/4" from the lugs on the terminal strip.
- () Place a 3/4" length of sleeving on each lead of a 47 k Ω , 2-watt (yellow-violet-orange) resistor.
- () Connect this resistor between lugs 3 (S-3) and 6 (S-5) of terminal strip BH.
- () Connect a 2" large blue wire to lug 1 of terminal strip BH (S-2). Insert the other end of the blue wire in hole MM on the circuit board. Then solder the wire to the foil.
- () Connect a 5" large blue wire to lug 1 of terminal strip BJ (S-3). Insert the other end of the blue wire to hole LL on the circuit board. Then solder the wire to the foil.
- () Cut off any excess length of wire protruding from holes MM and LL on the component side of the circuit board. CAUTION: Be sure you remove any wire lengths you may cut off.



CRT INSTALLATION

Refer to Pictorial 2-12 (fold-out from Page 39) for the following steps.



Detail 2-12A

- () Refer to Detail 2-12A and cut the cushion strip into two equal lengths. Then place the cut lengths on the CRT clamps as shown in Part 2 of the Detail.

WARNING: Be extremely careful when you handle the CRT due to its high vacuum. Do not strike, or subject it to more than moderate pressure at any time. A fracture of the glass could result in an implosion of considerable violence capable of causing personal injury.

- () Place a soft cloth on your work surface. Then open the CRT carton, carefully remove the tube, and place it face down on the cloth. CAUTION: In the following steps, be extremely careful not to knock the tube over.
- () Refer to Detail 2-12B (fold-out from Page 33) and reposition the CRT so the keyway is positioned as shown.
- () Locate the CRT shield and place it on the CRT so the slots in the shield are positioned as shown.

NOTE: The clamps you will install in the next step fit snugly between the CRT and CRT shield. Be very careful when you install these clamps.

- () Install the CRT clamps around the CRT, one at a time. Carefully work each clamp between the shield and the CRT.

- () Line up the holes in the CRT clamps with the slots in the CRT shield. Then insert 6-32 x 1" screws through the holes and slots as shown.

- () Refer to Detail 2-12C (fold-out from Page 33) and insert the front of the CRT into the CRT ring. Line up the 6-32 x 1" screws with the two mounting holes in the CRT support bracket. Then insert the screws in the mounting holes.

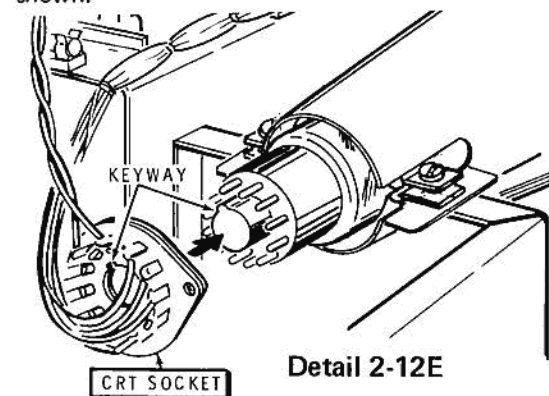
- () Make sure the keyway on the base of the CRT is positioned as shown.

- () Make sure the face of the CRT is flush with the front panel.

- () Install a #6 lockwasher and a 6-32 nut on each 6-32 x 1" screw. NOTE: Do not tighten the hardware until told to do so.

NOTE: The CRT graticule is marked with two scales on its front surface. Be sure you place it on the front panel so the scales read properly.

- () Refer to Detail 2-12D (fold-out from Page 33) and mount the CRT graticule and the bezel on the front panel with thumb nuts at the locations shown. Be sure the bezel is mounted so the notch is positioned as shown.



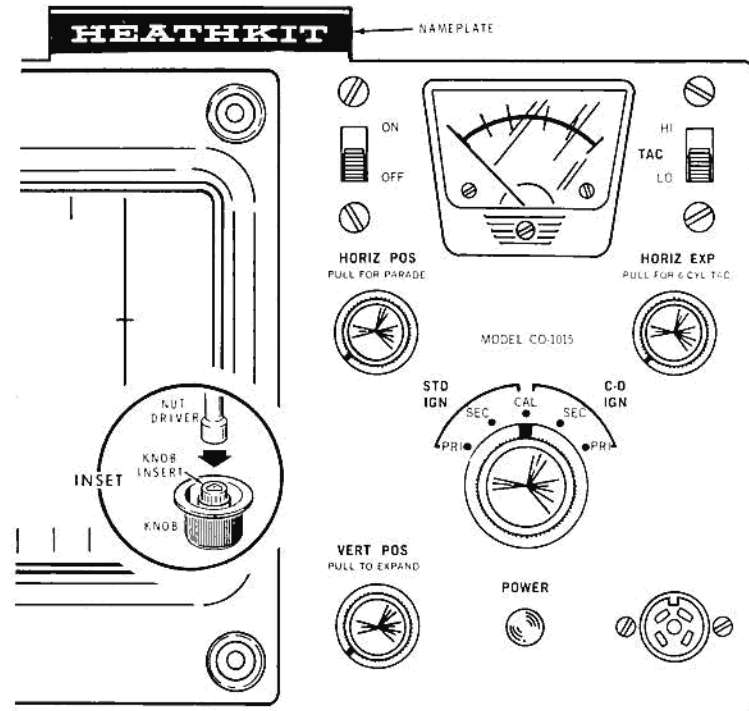
Detail 2-12E

- () Place a soft cloth or a newspaper on your work bench. Then stand the Analyzer in an upright position with its front panel face down on the bench.

- () Refer to Detail 2-12E and work the CRT socket onto the CRT base. NOTE: The socket will fit quite tightly on the tube base; therefore, press downward firmly until the socket is on the base.

- () Refer to Pictorial 2-12 and mount the handle on the top rail with two #10 lockwashers and two 10-32 nuts.

- () Mount the top rail to the front and rear panels with 8-32 screws at the four locations shown in the Pictorial. Position the top rail so the handle is toward the rear.



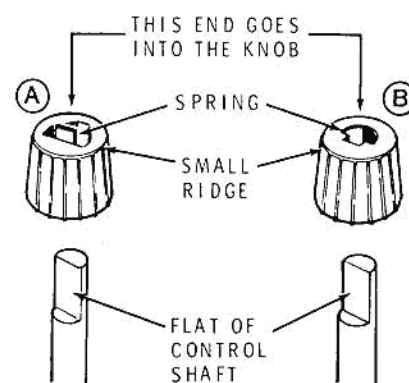
PICTORIAL 2-13

KNOB INSTALLATION

Refer to Pictorial 2-13 for the following steps.

- () Refer to Detail 2-13A and notice that the knob insert is tapered. When you place one of these inserts on a shaft, be sure the smaller end faces out or the knob will not slide onto the insert. If you are not sure which end is smaller, roll the insert across a flat surface; the insert will gradually turn toward the smaller end.
- () Press a knob insert onto the shaft of the selector switch, and turn the switch shaft counterclockwise as far as it will go.
- () Now turn the switch shaft clockwise two positions. NOTE: This is the CAL (center) position.
- () Position the large knob so its pointer mark is in line with the dot marked CAL as shown in the Pictorial. Then press the knob part way on the insert.
- () With the knob still part way on the insert, remove the insert from the switch shaft. Refer to the inset drawing on the Pictorial and, with a suitable tool, press the insert AS FAR AS IT WILL GO into the knob. Then install the knob on the selector switch shaft.
- () Press knob inserts onto the shafts of the Horizontal Position, Horizontal Expand, and Vertical Position controls. Then turn each control shaft to its fully counterclockwise position.
- () Refer to Pictorial 2-13 for the proper position of the knob pointer mark at each location. Then install a knob on each of these inserts in the same manner that you did for the selector switch.
- () Carefully peel the backing paper from the Heathkit nameplate. Press the nameplate in place on the front panel above the bezel as shown in the Pictorial.
- () Temporarily place the Analyzer to one side.

NOTE: The knob insert may look like either A or B below. It must go on the shaft as shown.



Detail 2-13A

PICKUP ASSEMBLY WIRING

Refer to Pictorial 2-14 (fold-out from Page 39) for the following steps.

- () Refer to Detail 2-14A and prepare one end of the 3-conductor cable as shown. This cable should be approximately 12 feet long.

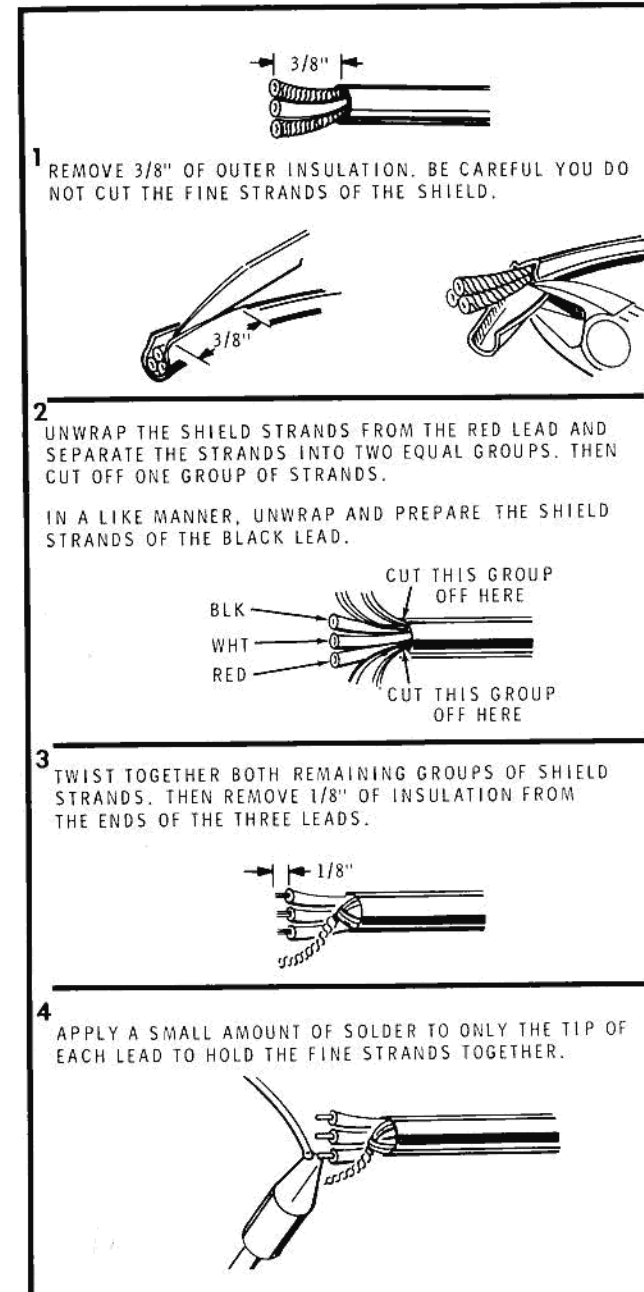
CAUTION: When you perform the next step, be sure you do not lose the 4-pin plug or its retaining screw.

- () Remove and save the retaining screw from the cable connector; then remove the 4-pin plug from the connector housing.
- () Slide the rubber insulator end of the connector housing over the 3/8" prepared end and onto the 3-conductor cable.

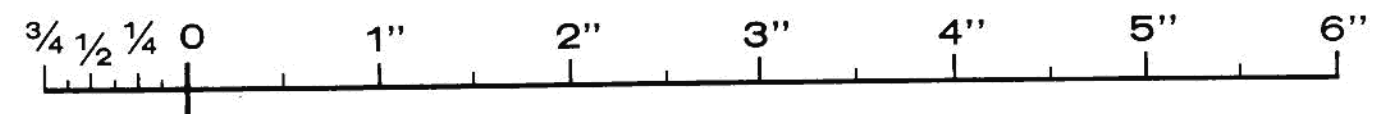
Connect the wires and shield lead at the prepared end of the 3-conductor cable to the 4-pin plug removed from the connector housing as directed in the following steps and shown in Detail 2-14B (fold-out from Page 39). The pin numbers are clearly marked on both the terminal (inside) and pin (outside) end of the plug.

NOTE: The three wires may be properly spaced and all inserted at one time in their proper pins and soldered; or, one wire at a time may be inserted and soldered in its proper pin. Use the method that is most convenient for you.

- () White to terminal 4 (S-1).
- () Red to terminal 3 (S-1).
- () Black to terminal 2 (S-1).
- () Shield to terminal 1 (S-1).

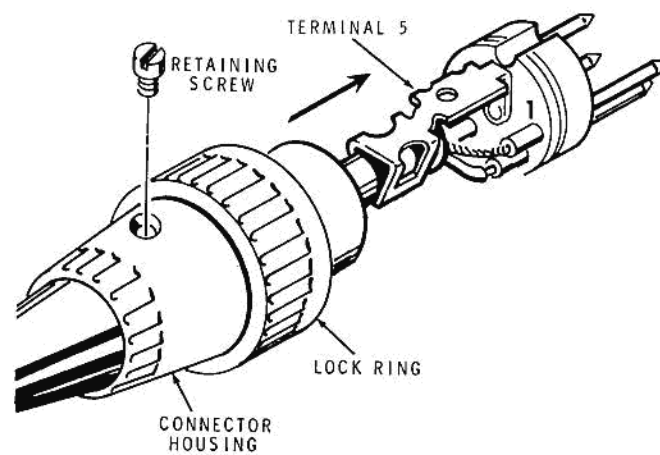


Detail 2-14A



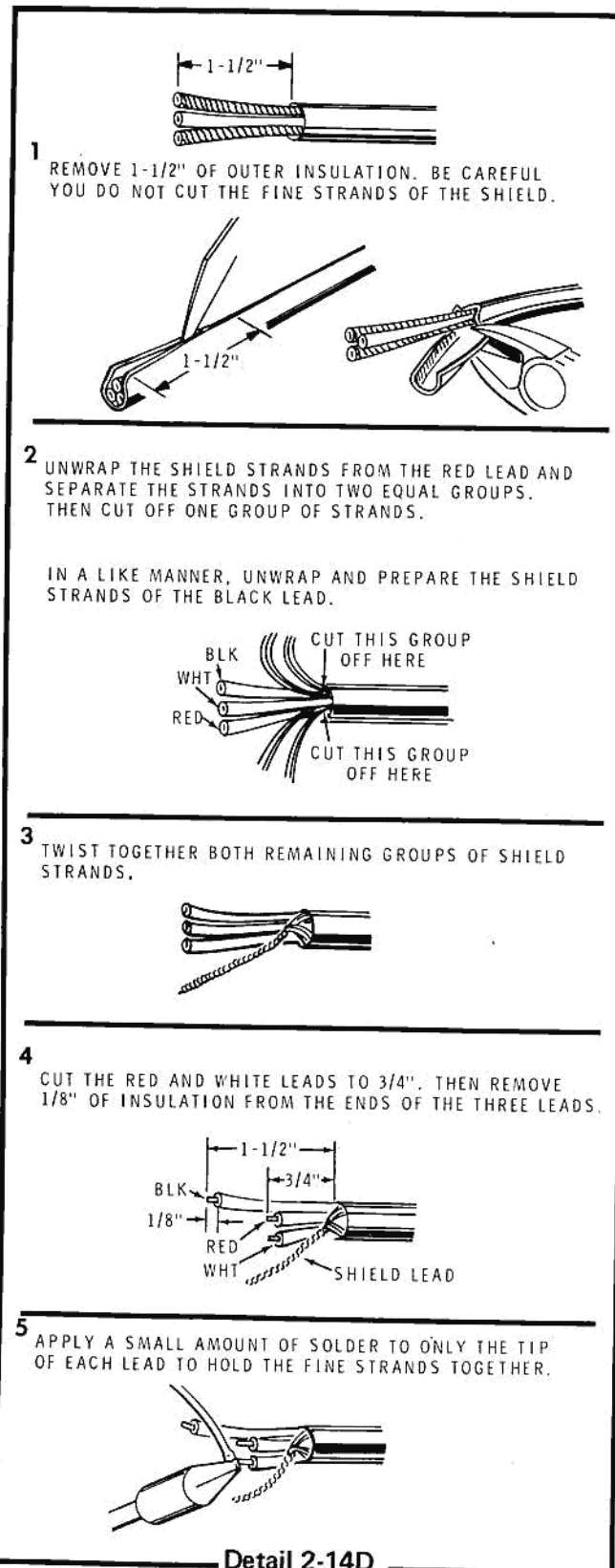
CAUTION: In the next step, the tabs must not contact the insulation on the white, red, or black wires in the cable. If necessary, push the cable toward the plug so that when you bend the tabs together they will only contact the outer insulation on the cable.

- () Carefully bend the tabs toward each other just enough to secure the cable.

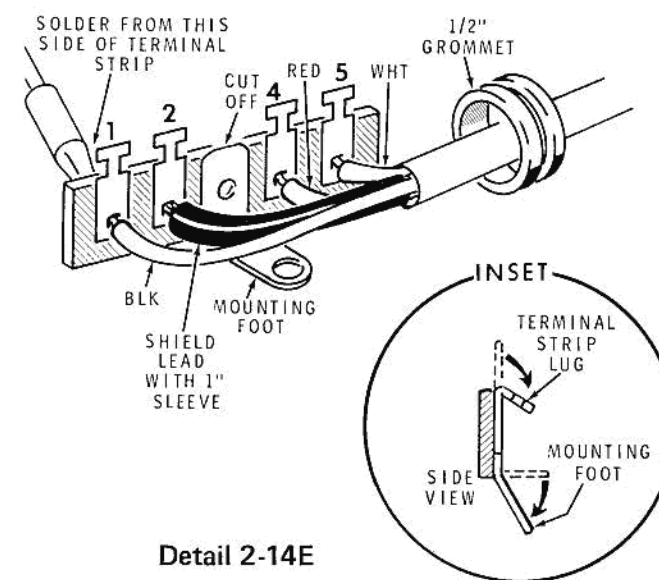
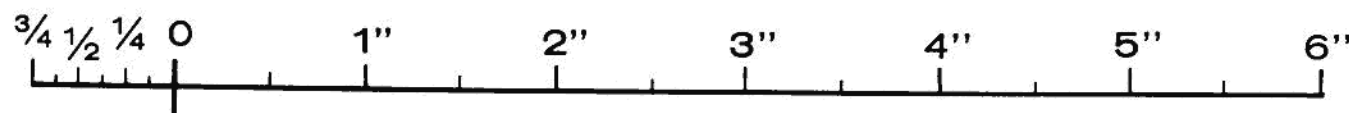


Detail 2-14C

- () Be sure the lock ring is on the connector housing. Then refer to Detail 2-14C and line up the hole in the connector housing with the hole in terminal 5 of the plug and push the housing onto the plug as far as it will go.
- () Secure the plug in the housing with the screw previously removed.
- () Prepare the other end of the 3-conductor cable as shown in Detail 2-14D.



Detail 2-14D



Detail 2-14E

Refer to Detail 2-14E for the following steps.

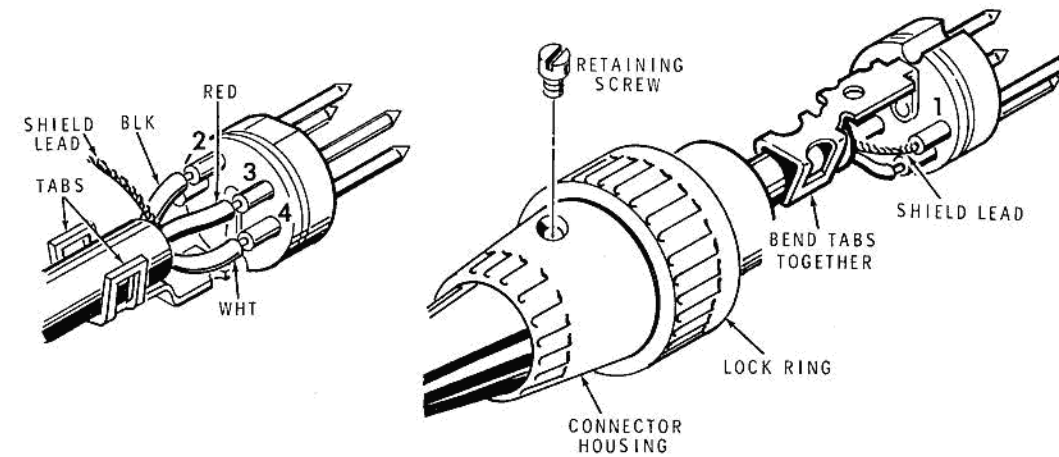
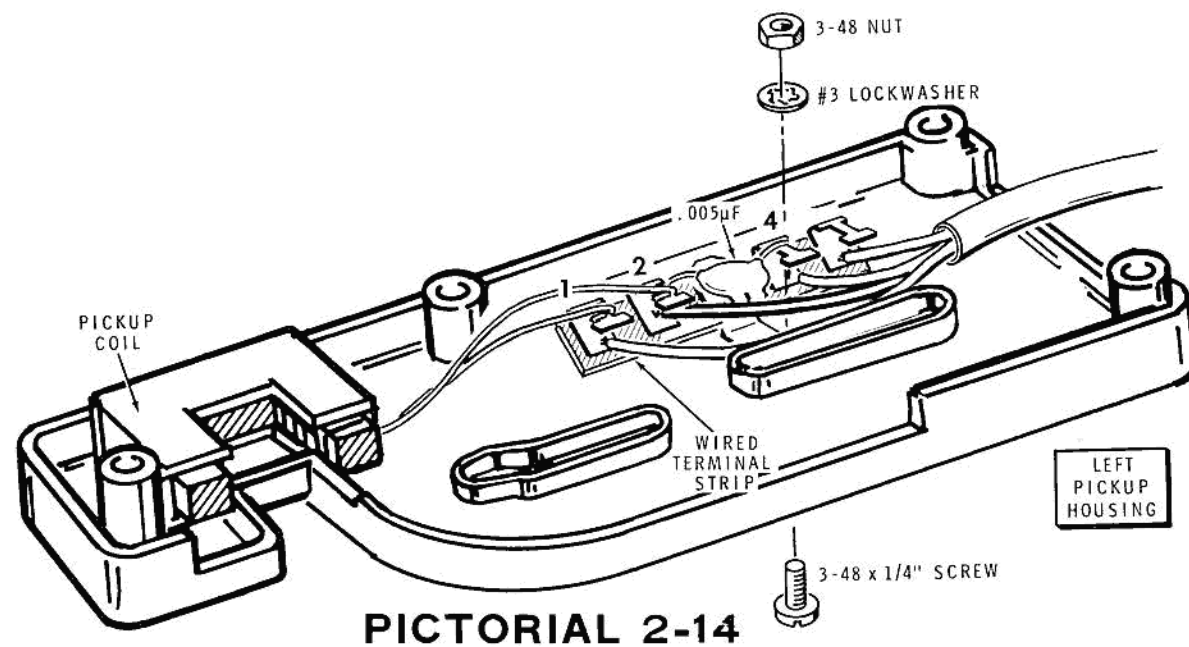
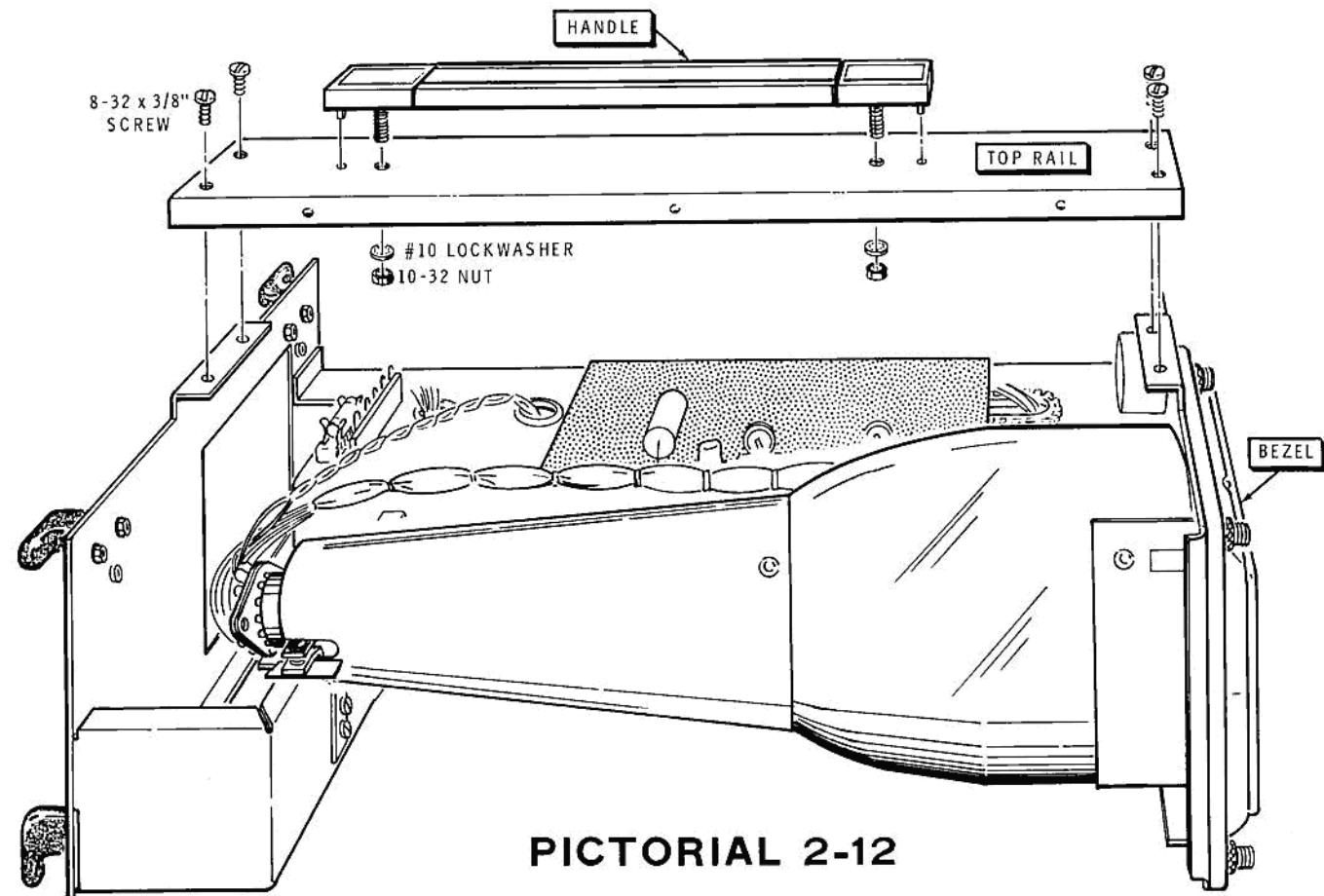
NOTE: In the following steps, make the solder connections as neat as possible. Also, be sure you position each component and each lead exactly as shown. Otherwise, the two halves of the pickup housing will not fit together.

- () Locate the small 5-lug terminal strip and cut off the top portion of the mounting foot as shown.
- () Place a 1/2" grommet on the free end of the 3-conductor cable. Push the grommet back from the end of the cable and out of the way.

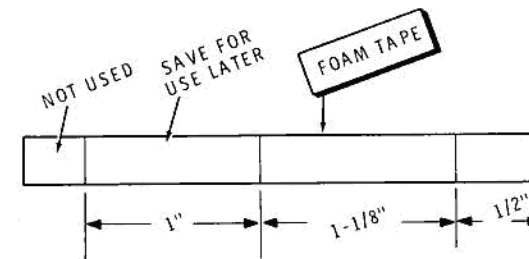
NOTE: When you solder in the following steps, apply the solder to the back of the terminal strip as shown. Cut off the excess length after each lead has been soldered in its eyelet.

- () Place 1" of sleeving on the shield lead of the 3-conductor cable. Then insert the lead in the eyelet of lug 2 of the prepared terminal strip (S-1).
- () Insert the black lead in the eyelet of lug 1 of the terminal strip (S-1).
- () Insert the red lead in the eyelet of lug 4 of the terminal strip (S-1).

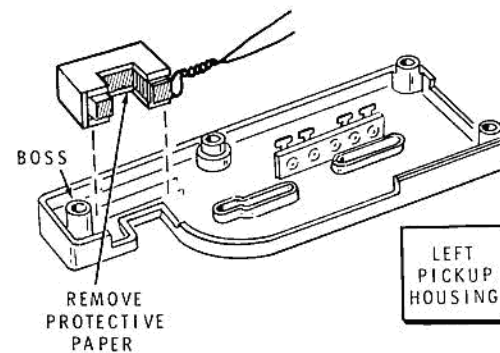
- () Insert the white lead in the eyelet of lug 5 of the terminal strip (S-1).
- () Carefully bend the mounting foot, and lugs 1, 2, 4, and 5 of the terminal strip as shown in the inset drawing on Detail 2-14E.
- () Mount the wired terminal strip in the left pickup housing with 3-48 x 1/4" hardware as shown in the Pictorial.
- () Carefully press the terminal strip backward and down into the pickup housing as far as it will go. NOTE: The lugs on the terminal strip must not rise above the side of the pickup housing.
- () Refer to Detail 2-14F and cut the length of foam tape into three pieces as shown.
- () Refer to Part A of Detail 2-14G and position the pickup coil (#40-1905) as shown. Then press the 1/2" piece of foam tape onto the pickup coil. Make sure the indicated end of the tape is even with the indicated edge of the pickup coil.
- () Refer to Part B of Detail 2-14G and install the 1-1/8" of foam tape as shown.
- () Refer to Part C of Detail 2-14G and remove the protective paper from the indicated side of a U-shaped piece of foam tape. NOTE THE POSITION OF THE WIDE LEG. Then press the tape onto the proper side of the coil.
- () In the same manner, install the other U-shaped piece of foam tape on the other side of the coil.
- () Refer to Detail 2-14H and remove the protective paper from the indicated piece of foam tape. Then press the pickup coil into place in the left pickup housing as shown.
- () Connect either lead of the inductor to lug 1 (S-1) and the other lead to lug 2 (NS) of the terminal strip.
- () Connect one lead of a .005 μ F disc capacitor to lug 2 of the terminal strip (NS) and the other lead to lug 4 (NS) of the terminal strip. Position the capacitor as shown.



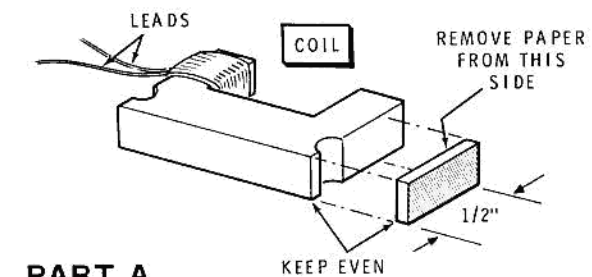
Detail 2-14B



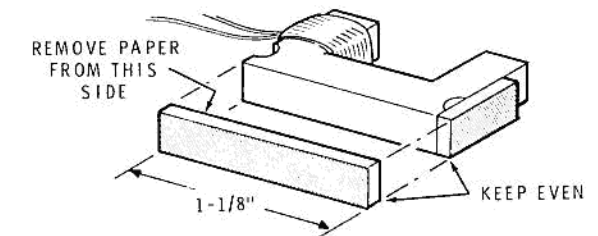
Detail 2-14F



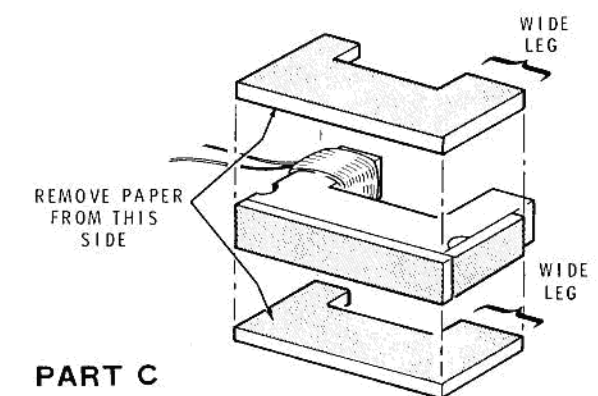
Detail 2-14H



PART A



PART B



PART C

Detail 2-14G

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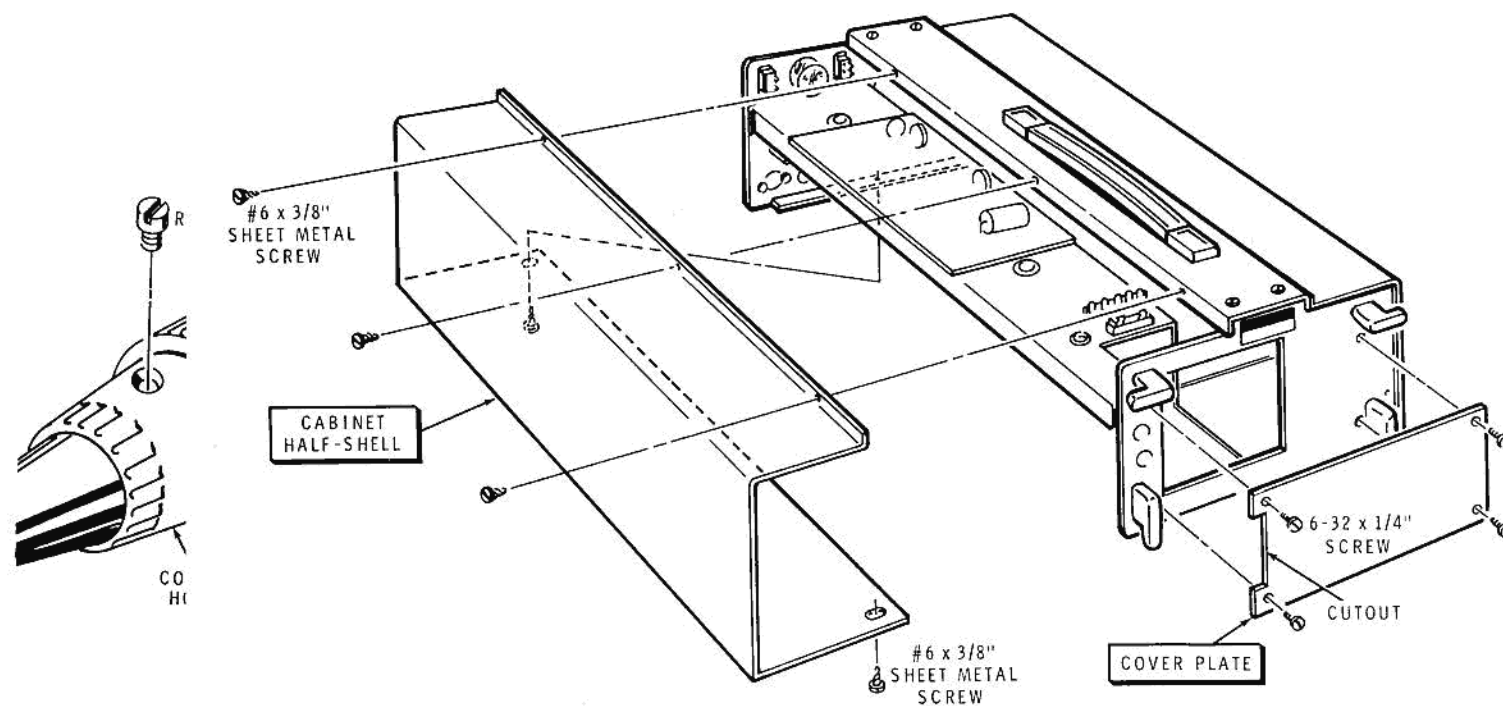
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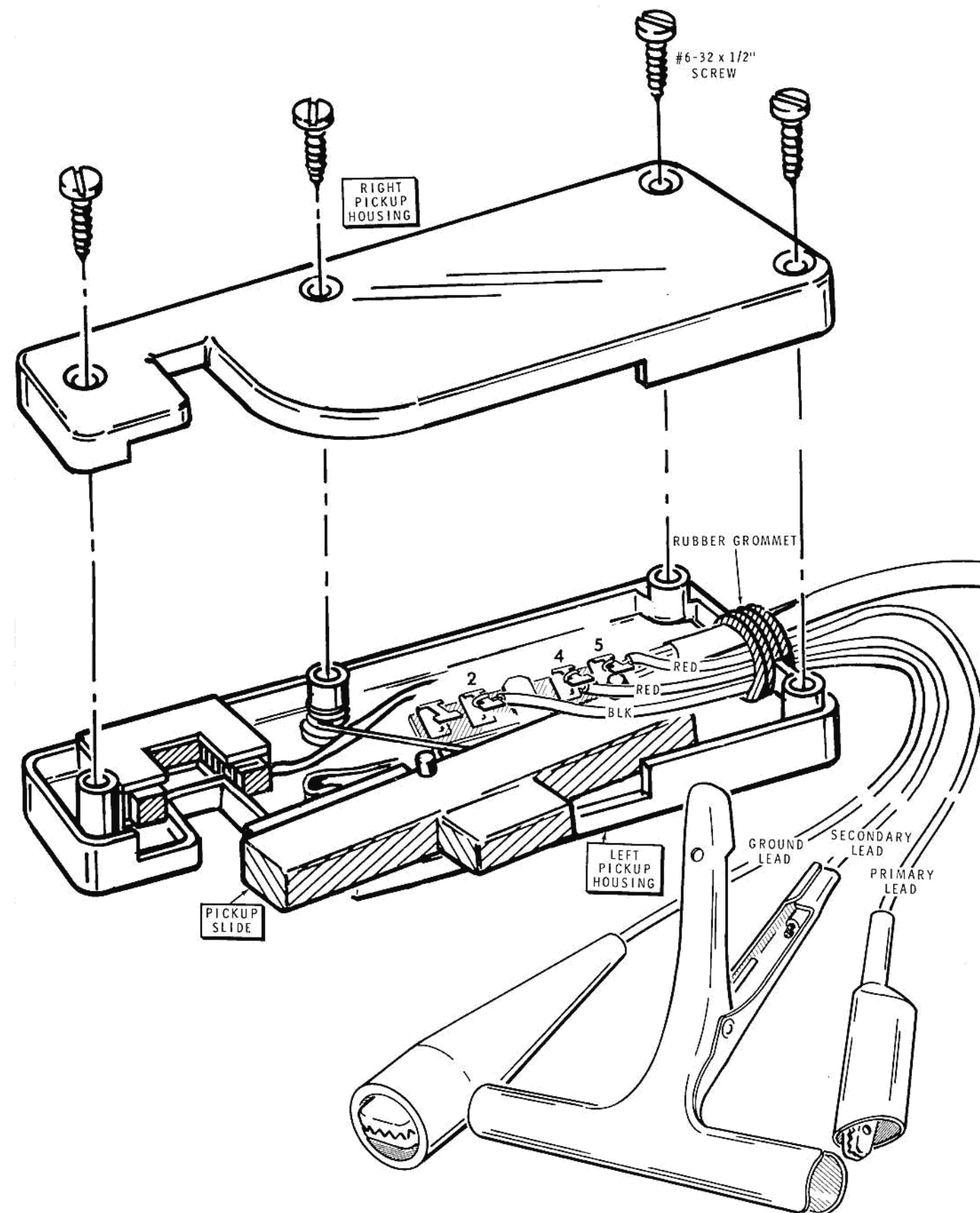
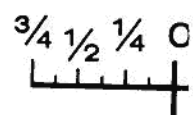


PICTORIAL 2-16

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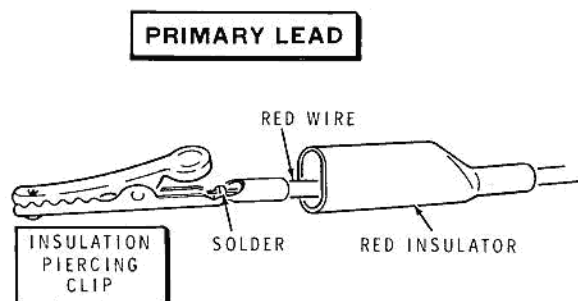
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PICTORIAL 2-15

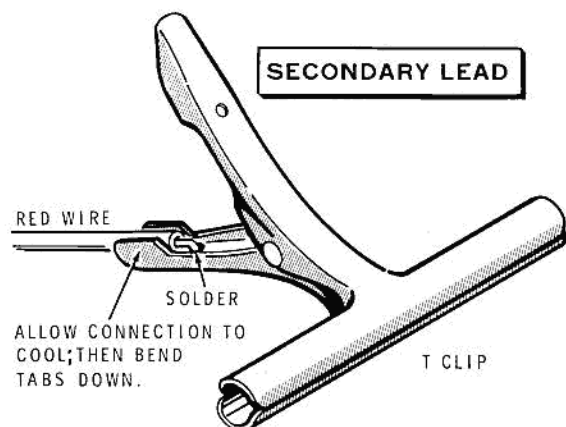
Refer to Pictorial 2-15 (fold-out from this page) for the following steps.

- () Cut the large red wire into two 24" lengths and the large black wire to 24".
- () Remove 1/4" of insulation from each end of the two large red wires and the large black wire. Then apply a small amount of solder to the ends of the wires to hold the small strands together.

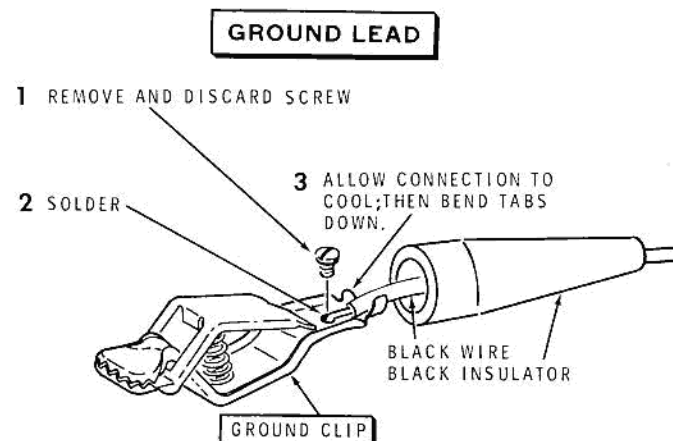


Detail 2-15A

- () Refer to Detail 2-15A and prepare a "primary" lead. Use a large red wire, a red insulator, and an insulation piercing clip as shown.
- () Insert the free end of this "primary" lead through the grommet on the 3-conductor cable, and connect it to lug 5 of the terminal strip in the left pickup housing (S-1).
- () Refer to Detail 2-15B and prepare a "secondary" lead. Use the remaining large red wire and the large T clip as shown.
- () Insert the free end of this "secondary" lead through the grommet on the 3-conductor cable and connect it to lug 4 of the terminal strip (S-2).



Detail 2-15B



Detail 2-15C

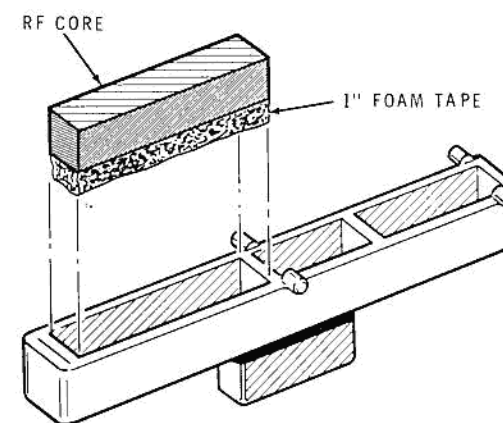
- () Refer to Detail 2-15C and prepare a "ground" lead. Use the large black wire, a black insulator, and a ground clip as shown.



- () Insert the free end of this "ground" lead through the grommet on the 3-conductor cable, and connect it to lug 2 of the terminal strip (S-3).
- () Slide the grommet on the cable and leads toward the cutout in the pickup housing. Flatten the cable and leads; then press the grommet down into the cutout in the pickup housing.

CAUTION: In the following steps, be very careful you do not break the right pickup housing when you install and secure it on the left pickup housing.

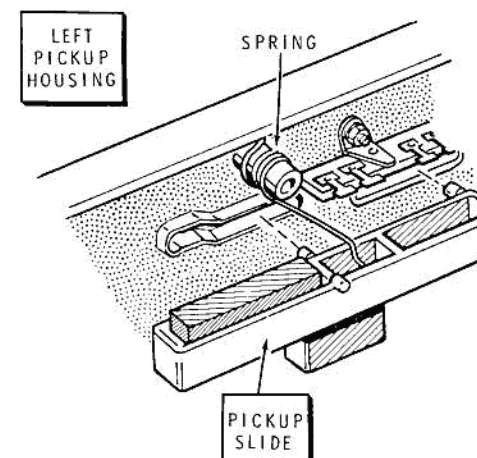
- () Refer to Detail 2-15E and install the spring and pickup slide in the left pickup housing. Operate the slide back-and-forth to be sure the leads are not in the way of the slide. If necessary, move them out of the way so the slide works freely.



Detail 2-15D

PICKUP SLIDE

- () Refer to Detail 2-15D and remove the protective paper from only one side of the 1" foam tape. Then press the tape onto the RF core.
- () Refer again to Detail 2-15D and remove the protective paper from the other side of the double-sided tape. Then press the tape and RF core into the pickup slide as shown.



Detail 2-15E

- () Refer to Pictorial 2-15 and install the right pickup housing on the pickup assembly with #6 x 1/2" screws. Be sure the housing fits into the groove of the rubber grommet, and over the pickup coil and the pickup slide. Try operating the pickup slide. The slide should move about half its travel distance towards the end of the pickup. Slight force may be necessary to push it the remaining distance.

This completes the wiring of your Ignition Analyzer. Proceed to "Tests and Adjustments."

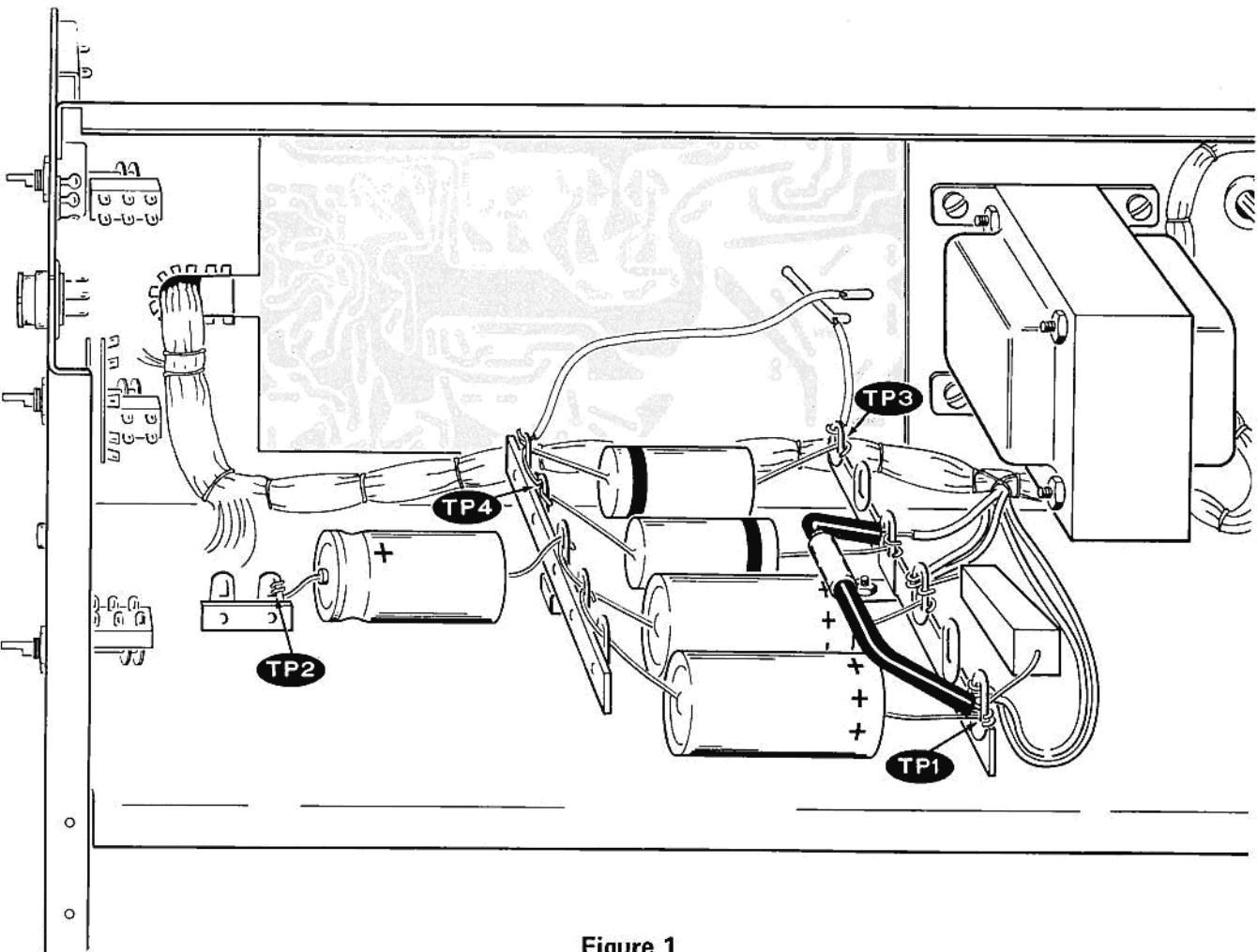


Figure 1

TESTS AND ADJUSTMENTS

TESTS

NOTE: An ohmmeter having a range capable of indicating 10 kΩ at center scale, and another range capable of indicating 1 MΩ at center scale, was used to obtain the following resistance measurements.

TEST POINT	MINIMUM RESISTANCE
() TP1	40 kΩ
() TP2	7500 Ω
() TP3	5 MΩ
() TP4	500 kΩ

Refer to Figure 1 and to the Schematic (fold-out from Page 75) for the location of the following test points. Then make the following measurements. The measurements were taken between the indicated test point and the chassis. Reverse the ohmmeter lead connections if the resistance readings are not as indicated.

If the resistance readings obtained were not as indicated, refer to the "In Case of Difficulty" and "Troubleshooting Chart" on Pages 59 through 61 in this Manual. If the resistance readings obtained were as indicated, proceed with the following "Adjustments."

ADJUSTMENTS

Figure 8 (fold-out from Page 55) shows the location and gives a brief description of the function of the front and rear panel switches and controls that will be referred to in the following steps.

Preset the front and rear panel controls and switches as follows:

- () Power switch OFF.
- () Selector switch CAL.
- () TAC switch LO.
- () HORIZ POS Knob pushed in and set at 12 o'clock position.

- () HORIZ EXP Knob pushed in and turned fully counterclockwise.
- () VERT POS Knob pushed in and set at 12 o'clock position.
- () FOCUS (on rear panel) Turned to center of rotation.
- () ASTIG (on rear panel) Turned to center of rotation.

CAUTION: Hazardous voltages will be present at test points TP1, TP2, TP3, TP4, the POWER switch, the fuseholder, the CRT socket, the terminal strip, and the circuit board connecting points of the power transformer when power is applied to the Analyzer. Be careful you do not come in contact with any of these points. See the boxed-in areas on the "Chassis Photographs" on Pages 69, 70, and 71.

NOTE: When the Analyzer is first turned on, the meter pointer will momentarily read full scale and then return to zero. As the Analyzer warms up, the meter may read anywhere on the scale. This is normal and does not indicate trouble.

- () Insert the line cord plug into the proper power outlet and place the power switch in the ON position.
- () The panel lamp should light immediately, and after about 30 seconds the CRT screen should display a sine wave pattern.

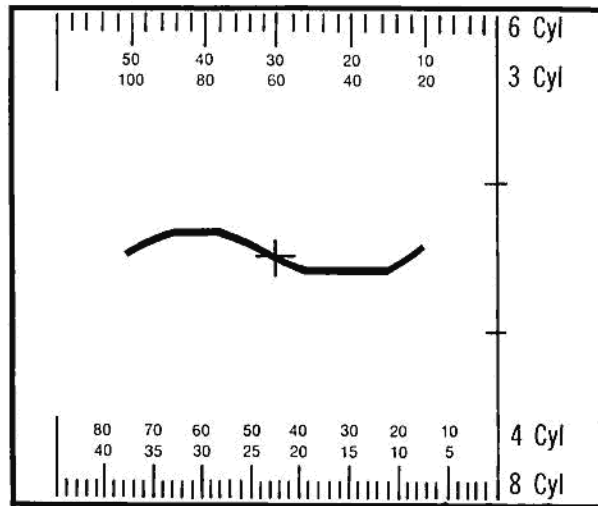


Figure 2

- () Adjust the VERT POS and HORIZ POS controls to place the pattern near the center of the CRT screen as shown in Figure 2. NOTE: The pattern will not fill the screen and it may be tilted at this time.

FOCUS AND ASTIGMATISM

- () Use the plastic alignment tool and alternately adjust the FOCUS and ASTIG controls on the rear panel until the sine wave pattern on the CRT screen is clear and distinct. Continue to alternately adjust these controls until no improvement can be obtained.

CRT ALIGNMENT (12C)

- () Adjust the VERT POS control and place the patterns slightly above the numbers at the bottom of the CRT screen.
- () Adjust the HORIZ POS control and place the right end of the pattern trace on the vertical line near the right side of the screen.
- () Slowly adjust the VERT POS control and, while observing the right end of the trace, move the pattern

to the top of the screen. The right end of the trace should not move away from the vertical line on the screen.

- () If the end of the trace follows the vertical line from top to bottom, no CRT Alignment is needed. If the end of the trace moved away from the vertical line, note the direction and the amount of movement. Then remove the power cord plug from the AC outlet.
- () Loosen the CRT clamp nuts, if necessary, to be sure the clamps are loose on the neck of the CRT.
- () If the trace moved to the right of the vertical line, lift up very lightly on the CRT socket; then very carefully turn the CRT slightly clockwise in its shield as viewed from the socket end of the CRT. If the end of the trace moved to the left of the vertical line, turn the CRT slightly counterclockwise in its shield.
- () Insert the power cord plug in the AC outlet and allow time for the trace to appear on the screen. Then again move the pattern up and down on the screen with the VERT POS control.

CAUTION: Remove the power cord plug from the AC outlet each time you adjust the position of the CRT.

- () Continue to adjust the position of the CRT until the end of the trace moves up and down on the screen in parallel with the vertical line.
- () Remove the power cord plug from the AC outlet. Then tighten the nuts on the CRT clamps just enough to prevent any movement of the CRT.

TACHOMETER CALIBRATION

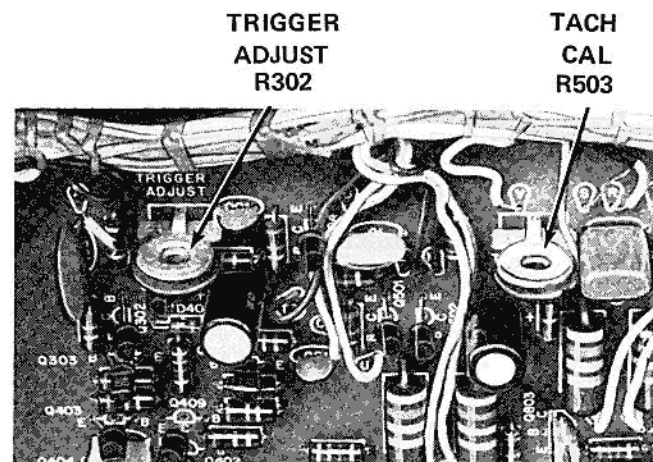


Figure 3

CAUTION: Calibrate the tachometer with the analyzer line cord plug inserted in an ac outlet that supplies power from your local electrical company (Public Utility). Do not calibrate the tachometer using an inverter or other electronic ac power supply as a power source.

The TAC CAL (tachometer calibrate) control R503 is mounted on the circuit board as shown in Figure 3. This control must be adjusted with a nonmetallic tool, such as the plastic alignment tool supplied with the kit, to prevent shorting the control to one of the transistors.

- () Refer to Figure 3 and, using the insulated tool, preset the TAC CAL control (R503) fully counterclockwise.

NOTE: You can calibrate the tachometer so correct RPM readings will be obtained when the Analyzer is operated from a 50 Hz power source or from a 60 Hz power source. (In the U.S.A. 60 Hz is used.) Choose the instructions that pertain to the power line frequency in your area and perform only those steps. Then proceed to "Trigger Adjustments."

60 Hz Calibration

- () Be sure the HORIZ EXP control knob is pushed in.
- () Refer to Figure 3 and, using the plastic alignment tool, turn the TAC CAL control, R503, clockwise until the meter pointer is positioned midway between 8 and 10 (900 rpm) on the 0 to 10 scale.
- () Place the TAC switch in the HI position; then pull out on the HORIZ EXP control knob. The meter should now read 12 (1200 rpm) on the 0 to 50 scale.

50 Hz Calibration

- () Pull out on the HORIZ EXP control knob.
- () Refer to Figure 3 and, using the plastic alignment tool, turn the TAC CAL control, R503, clockwise until the meter pointer is positioned at 10 (1000 rpm) on the 0 to 10 scale.

- () Push in on the HORIZ EXP control knob and place the TAC switch in the LO position. The meter should now read approximately 775 rpm on the 0 to 10 (0 to 1000 rpm) scale.

TRIGGER ADJUSTMENT

NOTE: Only make the trigger adjustments with the Analyzer connected to a properly operating vehicle engine and with the cabinet half-shell on the right side of the Analyzer removed. Figure 3 shows the location of TRIGGER ADJUST control R302.

- () Place the Analyzer on a bench or table near the engine to which it will be connected. Then insert the line cord plug into an appropriate ac power outlet. NOTE: If it is more convenient, you may stand the Analyzer in a vertical position on the cord retainers on the rear panel.

- () Plug the pickup cable connector into the connector socket on the front panel. Press in on the connector; then turn the ring clockwise to lock the connector in the socket.

Proceed to the "Connection Procedure" section on Page 5 of the "Operation Handbook" and perform the steps in that section. Then come back to this point in this Manual.

Refer to Figure 8 (fold-out from Page 55) for the following steps.

NOTE: If a 6-cylinder engine is used, pull out the HORIZ EXP knob and place the TAC switch in the LO position. If an 8-cylinder engine is used, push in the HORIZ EXP knob and place the TAC switch in the LO position.

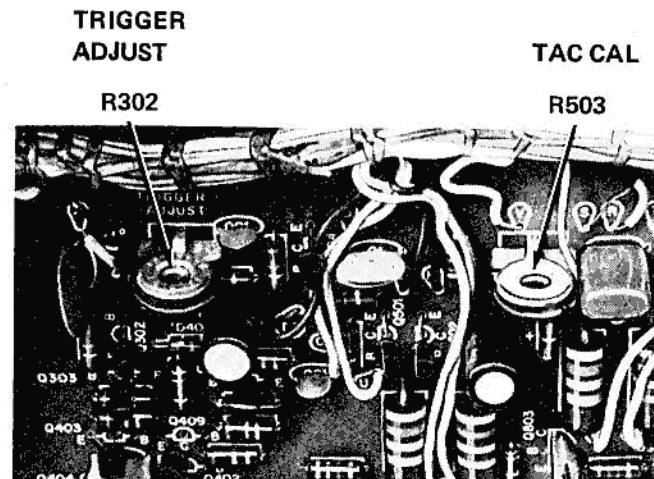


Figure 3
(Repeat)

- () Refer to Figure 3 and, using the insulated tool, preset the TRIGGER ADJUST control (R302) fully counterclockwise.
- () Place the TAC switch in the LO position and the selector switch in the CAL position.
- () Place the power switch in the ON position and allow at least one minute for the Analyzer to reach operating temperature.
- () Adjust the HORIZ POS and VERT POS controls to place the trace at the center of the CRT screen. Then adjust the HORIZ EXP control until the trace extends completely across the CRT screen.

WARNING: Before you start the engine in the next step, be sure the Pickup Cable and its leads and clips are away from the engine cooling fan, drive belts and pulleys, and exhaust manifold.

TAC CAL

R503

- () Start the engine. Then turn the selector switch to the standard Ignition (or Capacitive-Discharge Ignition) SEC position and place the TAC switch in the LO position.
- () Pull out on the HORIZ POS control knob. The meter reading should drop to zero and a parade pattern with sections equal to the number of engine cylinders should appear on the CRT screen.

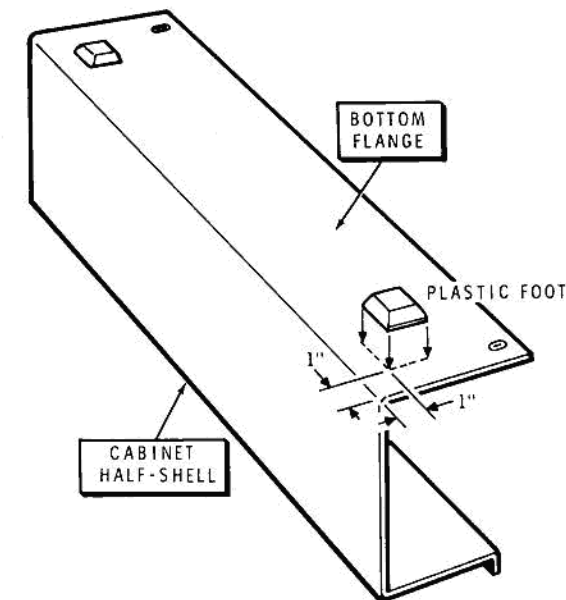
NOTE: If the complete pattern is unstable, (moves to the right and off the screen), perform the next two steps. If the pattern is stable (all cylinder firing patterns remain on CRT screen), disregard the next two steps and proceed to "Final Assembly" on Page 47.

Refer to Figure 3 and adjust the TRIGGER ADJUST control as directed in the following steps.

- () Use the plastic alignment tool and very slowly turn the TRIGGER ADJUST control, R302, clockwise until the pattern on the screen becomes stable.
- () Now continue to turn the TRIGGER ADJUST control clockwise just until the pattern starts to become erratic. Then turn the control 1/8-turn counterclockwise.
- () Pull out the VERT POS control. The pattern on the screen should expand.
- () Switch through the PRI (primary) and SEC (secondary) positions for both STD IGN and C-D IGN. The patterns for both PRI positions should be similar, and the patterns for both SEC positions should be similar.

This completes the "Tests and Adjustments" of your Ignition Analyzer.

FINAL ASSEMBLY



Detail 2-16A

- () In the same manner, install two plastic feet on the other cabinet half-shell.

Refer to Pictorial 2-16 (fold-out from Page 40) for the following steps.

- () Position the wiring harness wires out of the way so they will not be pinched by a cabinet half-shell.

NOTE: Prethread the ten holes used to secure the cabinet half-shells to the chassis assembly. Six of these holes are in the top rail and two each are in the bottom flanges of the front and rear panels.

- () Use the ten #6 x 3/8" sheet metal screws supplied with the kit and prethread the ten half-shell mounting holes in the chassis assembly. Use a different screw for prethreading each hole.

- () Secure each cabinet half-shell to the chassis assembly with five #6 x 3/8" sheet metal screws as shown.

Refer to Detail 2-16A for the following steps.

- () Remove the backing paper from two plastic feet. Refer to the dimensions shown on the Detail and install the feet on the bottom flange of one cabinet half-shell at the indicated locations.

- () Mount the cover plate on the rear panel with 6-32 x 1/4" screws. Be sure you position the cover plate cut-out as shown in the Pictorial.

This completes the assembly of your Solid-State Ignition Analyzer.

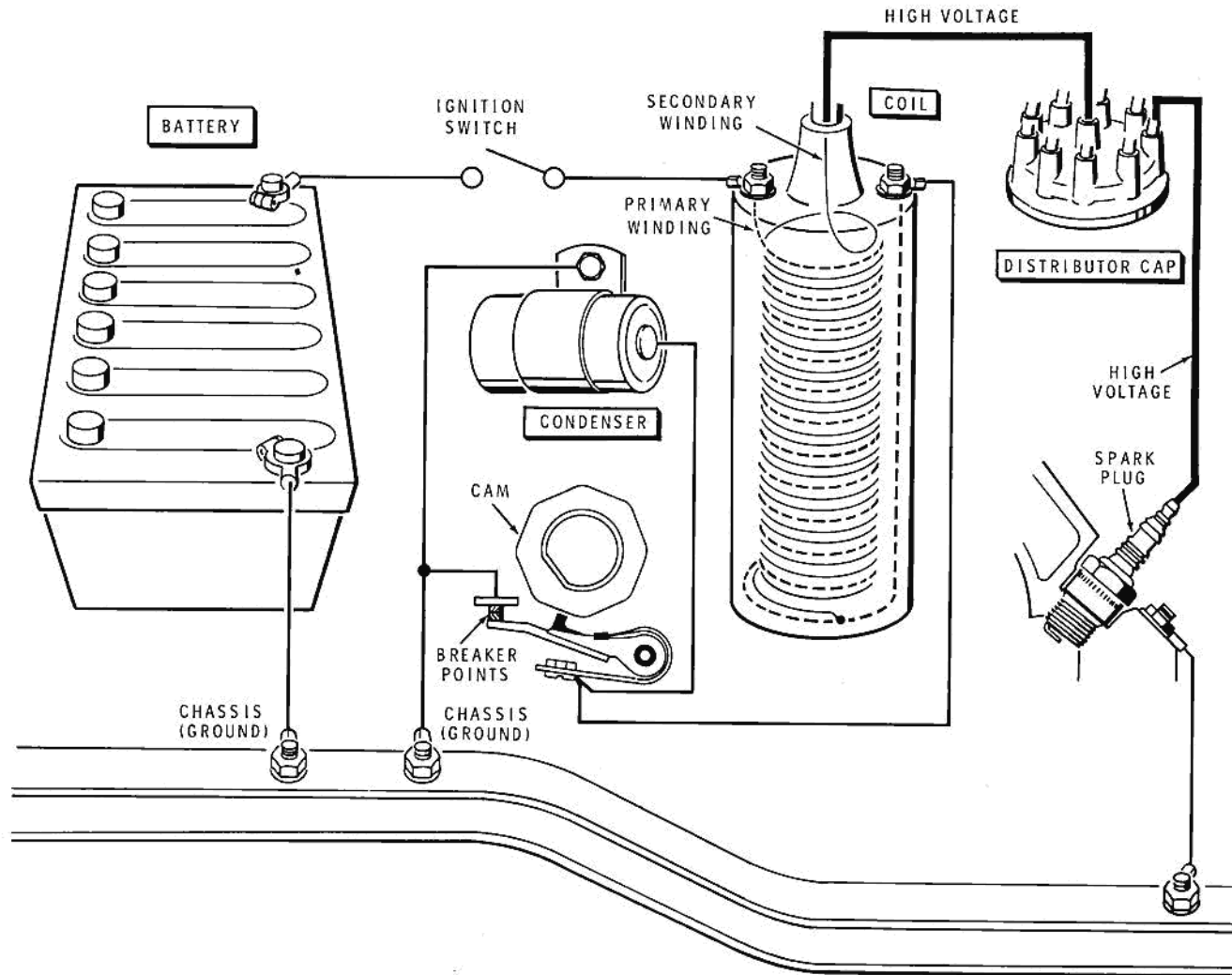


Figure 4

INTRODUCTION TO IGNITION ANALYSIS

As with any fine instrument, your Heathkit Model CO-1015 must be thoroughly understood to fully realize the vast amount of information it presents. Only through close examination of the areas of the visual display can you obtain a complete and meaningful analysis of the ignition system being tested. With this in mind, the following information is presented to increase your understanding of this important diagnostic tool.

STANDARD IGNITION SYSTEM

Refer to Figure 4 as you read the following paragraphs.

The main parts of a standard ignition system are the battery, the coil, the distributor, and the spark plugs. Located within the distributor is a cam that revolves to open and close the breaker points. While the breaker points are closed, a complete circuit is formed to allow battery current to flow through the primary winding of the coil. This current causes an intense magnetic field to form around the primary winding of the coil during the dwell time. When the breaker points open the magnetic field rapidly collapses and induces a high voltage in the secondary winding which can easily approach fifteen to twenty thousand volts. This surge of high voltage, which occurs each time the breaker points open, is fed back to the distributor where the rotor (a rotating switch) applies it to the proper spark plug in the firing order. The condenser across the distributor breaker points provides the clean electrical break necessary to produce proper high voltage and prevents the points from arcing and burning.

The various components of the engine ignition system produce complex voltage signal pulses. Your Ignition Analyzer converts these signal pulses into a visual pattern on the CRT screen. Comparison of the actual displayed pattern with the normal pattern produced by a properly operating

ignition system enables you to spot any deviation from normal and to pinpoint the area of trouble. Therefore, it is necessary for you to know how each part of the ignition system will affect a normal pattern.

The Analyzer will display a superimposed primary or superimposed secondary pattern in which the firing patterns of all engine cylinders are shown simultaneously one on top of the other. It will also display a primary or secondary "parade" pattern in which the firing patterns of all engine cylinders are shown from left to right across the screen in their normal firing order. The primary superimposed pattern is most useful in locating troubles that may occur due to a poor connection anywhere between the vehicle battery and the grounded side of the breaker points in the distributor. The secondary superimposed pattern is most useful in locating troubles that may occur in the high voltage circuits between the ignition coil and the spark plugs. The "parade" pattern is used to determine if one or more firing patterns are not normal and, if so, which engine cylinders are involved.

The patterns shown in the following Figures and in the "Operation Handbook," supplied with the kit, show patterns obtained from an engine with a negative ground electrical system. That is, the negative (—) terminal of the battery is connected to the vehicle frame. A positive ground system (positive battery terminal connected to the vehicle frame) will produce a primary pattern that is inverted from those shown in the various primary pattern Figures. The secondary patterns will be the same for both negative and positive ground systems.

For ease of understanding, the following charts are divided into sections that correspond to the pattern areas A to B, B to C, and C to D, of Figure 5A and Figure 5B on Pages 50 and 51. Refer to these pattern areas to follow the sequence of events listed in the charts.

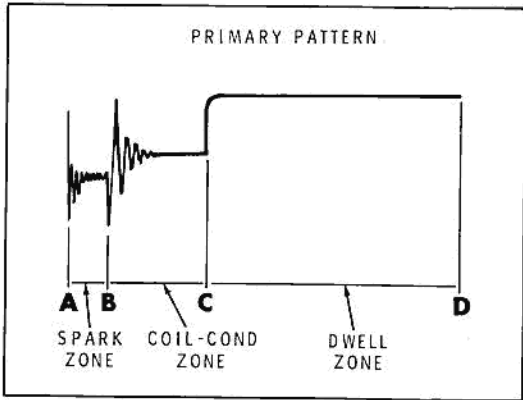


Figure 5A

Primary Pattern (Figure 5A)

A	(Points open signal)	1. Breaker points open. Produces high voltage in coil secondary winding and spark plug fires.
A-B	(Spark zone)	1. High voltage is directed by the distributor to the correct spark plug for firing.
B-C	(Coil-condenser zone)	1. Spark plug stops firing. Coil-condenser oscillations show unused coil energy being dissipated to ground.
C	(Points close signal)	1. Start of current flow through coil primary.
C-D	(Dwell zone)	1. Current flow through the coil primary rebuilds the magnetic field around both windings.

This completes the firing cycle for one cylinder. At D the breaker points open again and the firing pattern sequence is repeated for the next cylinder in the firing order.

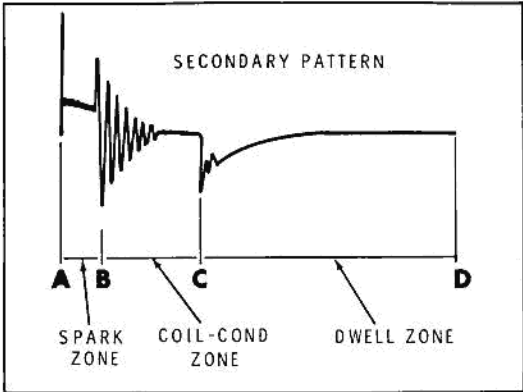


Figure 5B

Secondary Pattern (Figure 5B)

A	(Plug firing signal)	1. Breaker points open. Produces high voltage in coil secondary winding and spark plug fires.
A-B	(Spark zone)	1. Firing time of spark plug. Once spark is started at A, a lower voltage sustains the firing to B. 2. Because the coil-condenser oscillations that occur in the primary circuit are not reflected, the secondary pattern shows a horizontal line during the time that the spark plug fires. This line, called the "Spark Line," is very important since any deviations in this zone reflect difficulties in the high voltage circuits.
B-C	(Coil-condenser zone)	1. Spark plug stops firing. Coil-condenser oscillations show unused coil energy being dissipated to ground.
C	(Points close signal)	1. Start of current flow through coil primary. 2. When the breaker points close there is a voltage induced in the secondary winding which oscillates for a short period of time. This signal, which is shown in the secondary pattern, is very important since it reflects the proper closing of the points. 3. Indicates setting (degrees of dwell) of distributor breaker points.
C-D	(Dwell zone)	1. Current flow through the coil primary rebuilds the magnetic field around both windings.

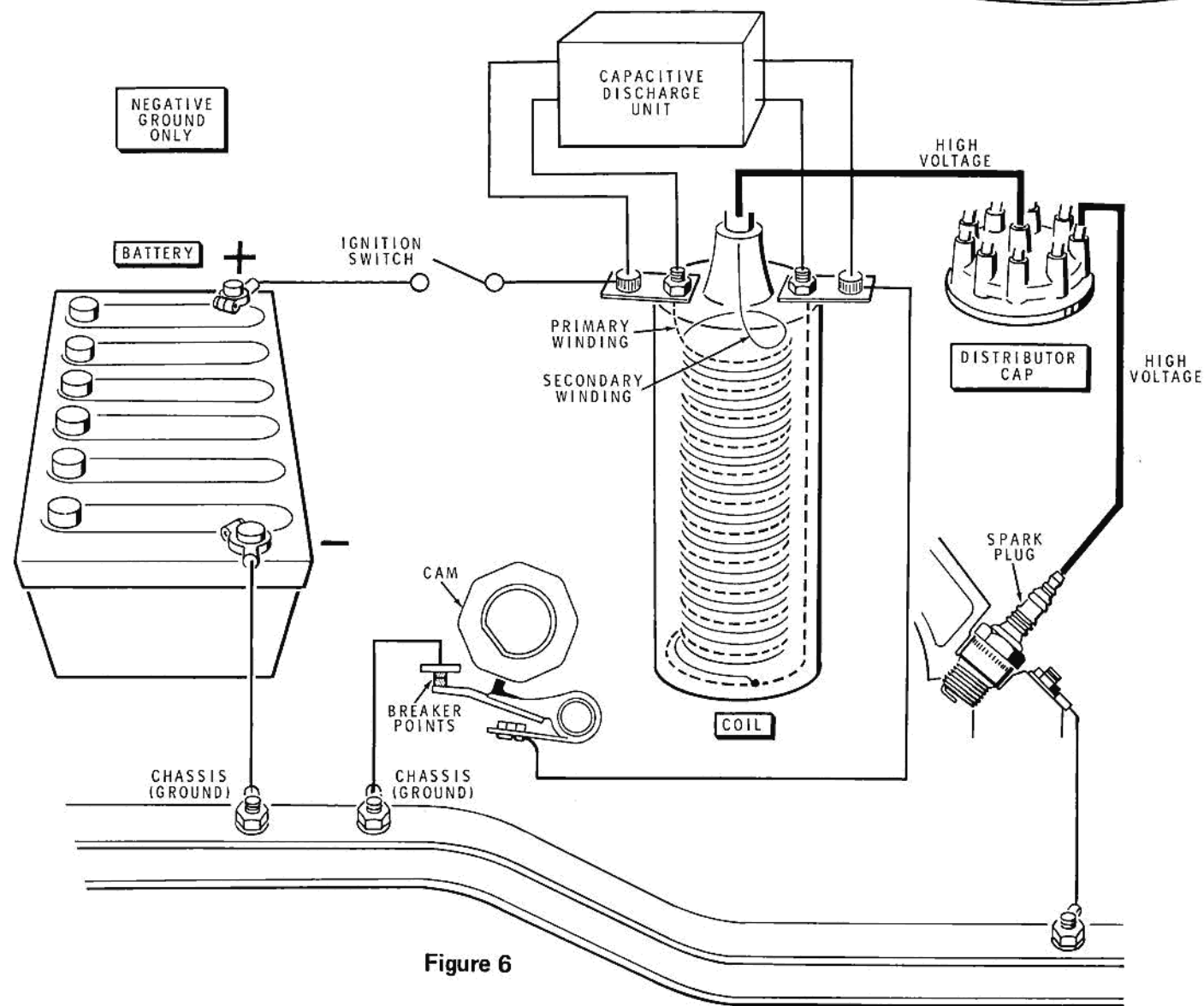


Figure 6

Capacitive-Discharge Ignition System

Refer to Figure 6 as you read the following paragraphs.

In addition to the vehicle battery, coil, distributor, and spark plugs, a capacitive-discharge ignition system contains an electronic unit that is triggered by the points open signal from the vehicle distributor. Each time the capacitive-discharge system is triggered, approximately 400 Vdc is discharged into the primary winding of the vehicle ignition coil. As a result of this high voltage pulse, which creates a much more intense field in the ignition coil, a much higher voltage is available to fire the spark plugs.

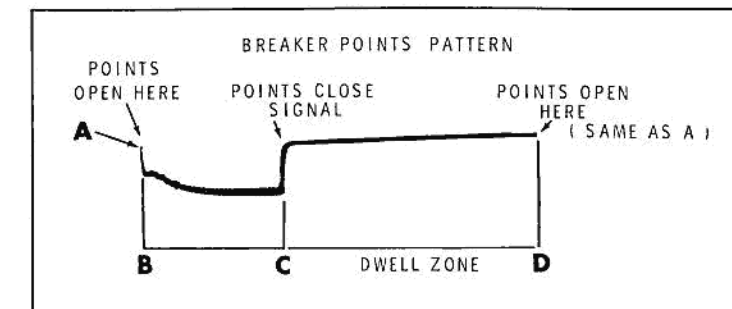
When the Analyzer is used on an engine equipped with a capacitive-discharge ignition system, the Analyzer should be operated with its selector switch in the C-D IGN mode. With

the selector switch in the capacitive-discharge SEC position, the display on the CRT screen will be a superimposed secondary pattern. With the selector switch in the PRI position, the display on the CRT screen will be a superimposed points signal.

NOTE: Although the Analyzer's Primary lead is connected to the breaker points as for a Standard Ignition system, the only signal present will be the points signal (a rectangular waveform). This is because in a capacitive-discharge system, the breaker points are not connected to the primary winding of the ignition coil.

For ease of understanding, the following charts are divided into sections that correspond to the pattern areas A to B, B to C, and C to D of Figures 7A and 7B. Refer to these pattern areas to follow the sequence of events listed in the charts.

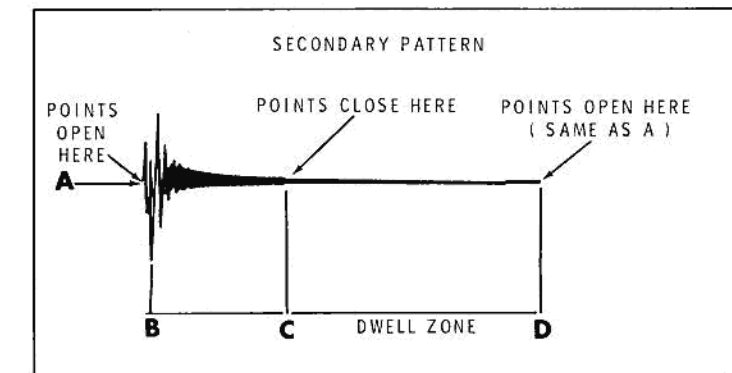
Figure 7A



Breaker Points Pattern (Figure 7A)

- | | | |
|-----|----------------------|--|
| A | (Points open signal) | 1. Triggers capacitive-discharge unit. |
| A-B | (Spark zone) | 1. Very short spark plug firing time. Plug stops firing at B. |
| B-C | (Coil zone) | 1. Since Analyzer primary lead is not connected to ignition coil, no signal is present to cause vertical deflection of sweep signal. |
| C-D | (Dwell zone) | 1. Indicates setting (degrees of dwell) of distributor breaker points. |

Figure 7B



Secondary Pattern (Figure 7B)

- | | | |
|-----|----------------------|---|
| A | (Points open signal) | 1. Output pulse from capacitive-discharge unit produces high voltage output from vehicle ignition coil to fire spark plug. |
| A-B | (Spark zone) | 1. Very short spark plug firing time. Plug stops firing at B. |
| B-C | (Coil zone) | 1. Shows rapid decay of coil energy to essentially zero at C. |
| C-D | (Dwell zone) | 1. Dwell zone will be the same as that shown in Figure 7A. Point C can hardly be seen in secondary pattern of capacitive-discharge ignition system. |



AC-Delco High Energy Ignition System

The patterns shown in the following Figures show patterns obtained from an HEI System using the Ignition Analyzer and the Distributor Adapter.

For ease of understanding, the following charts are divided into sections that correspond to the pattern areas A to B, B to C, C to E, and D to E, of Figure 8A and 8B. Refer to these pattern areas to follow the sequence of events listed in the charts.

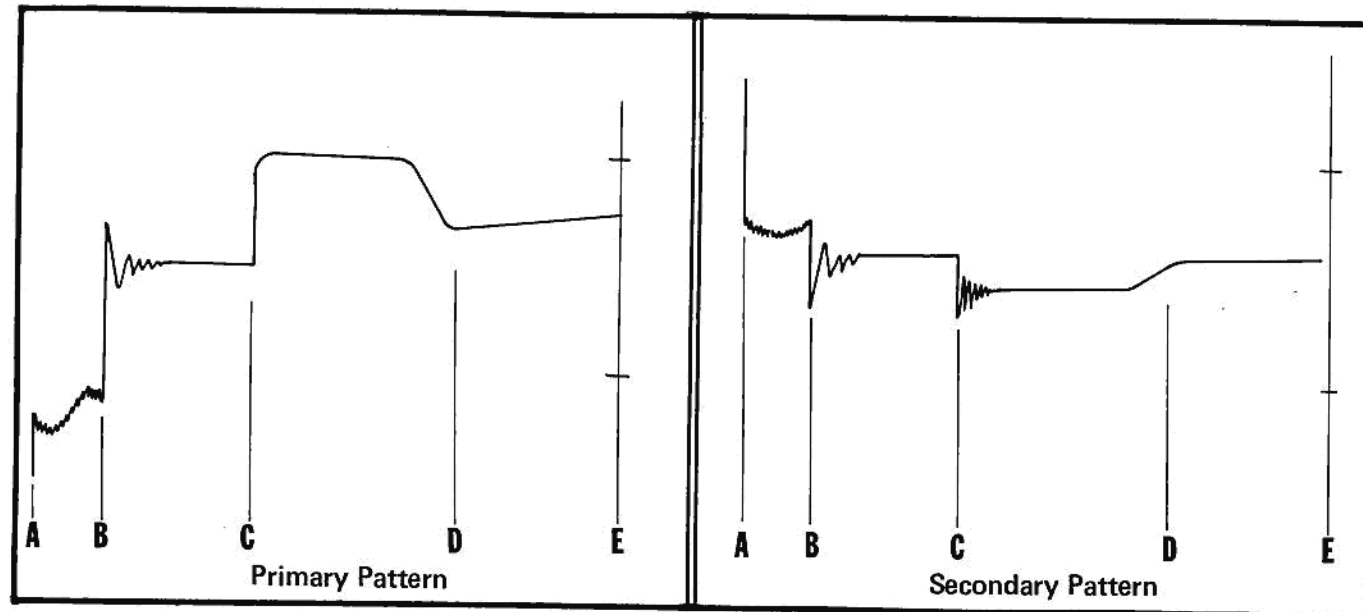


Figure 8A

Figure 8B

Primary and Secondary Patterns

- | | |
|--------------------------|---|
| A (Plug firing signal) | 1. Transistor turns off, producing high voltage in coil secondary winding and spark plug fires. |
| A-B (Spark zone) | 1. Firing time of spark plug. Plug stops firing at B. |
| B-C (Coil zone) | 1. Unused coil energy being dissipated. |
| C-E (Transistor on-time) | 1. Current flows in coil primary to rebuild magnetic field around both coil windings. |
| D-E (Current limit zone) | 1. This system has no ballast resistor. Current is limited electronically to protect coil from heat damage. |

NOTE: It is normal in this system for dwell to change with rpm.

OPERATION

The amount of information you obtain from your Analyzer depends to a great extent upon your knowledge of the controls. Refer to Figure 8 and read the information about each control function before you proceed.

Always perform the following preoperation adjustments before you start an ignition analysis.

1. Push the POWER switch to the OFF position.
2. Push the TAC switch to the LO position.
3. Push the HORIZ POS control to the IN position.
4. Plug the line cord into an ac outlet of the proper voltage (120 or 240 Vac). NOTE: If you use the Inverter Accessory instead of an AC outlet, the scope pattern will not be a sine wave. It will appear as a distorted square wave pattern.
5. Push the POWER switch to the ON position. The POWER lamp should light and the meter pointer momentarily read full scale. This is normal.
6. Turn the selector switch to the CAL position. Allow two to three minutes warmup time.
7. Turn the HORIZ POS control until the trace is horizontally centered on the screen.
8. Push the VERT POS control to the IN position.
9. Turn the VERT POS control until the trace is vertically centered on the screen.
10. Pull or Push the HORIZ EXP control to match the number of cylinders in the system being tested. (Pull out for 3 and 6 cylinder engines; push in for 4 and 8 cylinder engines.)
11. Turn the HORIZ EXP and HORIZ POS controls as necessary to adjust the length of the trace to the limits of the appropriate dwell angle scales.

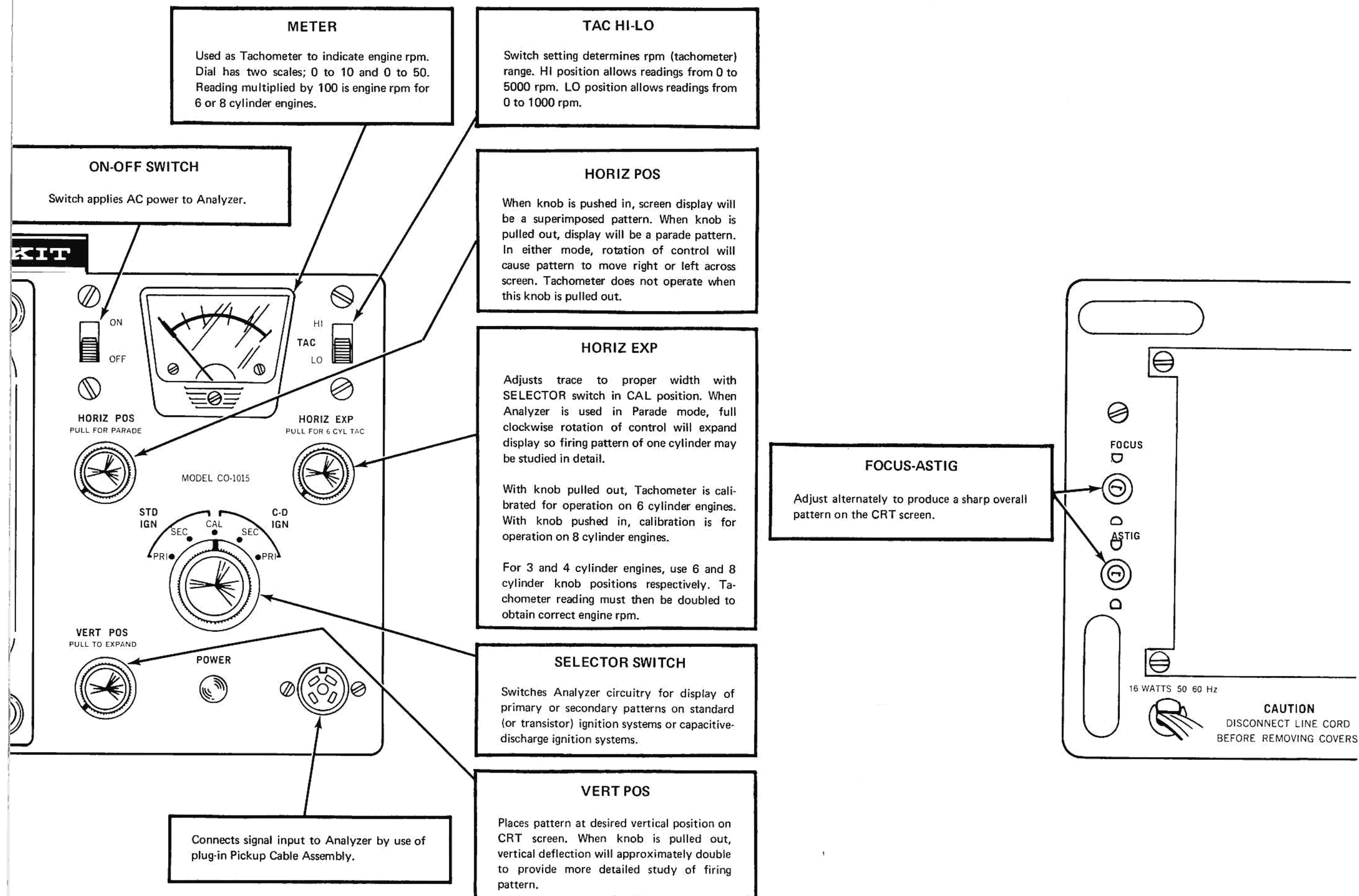


Figure 8

ANALYZER CONNECTION PROCEDURE

Use the following procedure to connect your Solid-State Ignition Analyzer to the ignition system you want to test.

Refer to Figure 9 as you perform the following steps.

- () Place the Analyzer in a convenient position near the ignition system.
- () Connect the Cable Connector end of the test cable to the Analyzer.
- () Clip the black lead coming from the pickup assembly to a good engine ground.
- () Clip the Secondary Lead T clip over the insulation of the high voltage lead between the ignition coil and the center terminal of the distributor cap. Be sure this clip does not touch any metal surface and that the high voltage lead is seated in the curved halves of the T clip.

NOTE: The following connection starts the "parade" pattern with the #1 cylinder. The remaining cylinder patterns are displayed in their normal firing order. For example, on a 6-cylinder engine with a firing order of 1-5-3-6-2-4, the parade pattern on the CRT screen will be displayed in the same order. On this same engine, if the pickup assembly is clamped around the #3 spark plug wire, the "parade" pattern will start with the #3 cylinder, and will be displayed on the CRT screen in a 3-6-2-4-1-5 order. Only the display sequence of the firing patterns will change.

IGNITION TESTS

This section of the Manual contains two ignition test procedures. Read the "General" information presented in the following paragraphs; then proceed with the ignition test procedure that corresponds to the type of system you want to test.

NOTES:

1. It is very important that you read and understand the information presented in "Introduction To Ignition Analysis" on Page 49, "Operation" information on Page 55, and "Analyzer Connection Procedure" on this page before you attempt an ignition test.
2. Tune-up specifications can be found in your car's Owners Manual, or you can obtain a specification book from your local automotive parts store.

General

Your Solid-State Ignition Analyzer can be used to check the ignition system of an improperly operating engine, to verify

- () Clip the pickup assembly around the #1 spark plug wire. Be sure that the pickup assembly is completely around the wire and that it is located as close as practical to the spark plug without actually touching the plug.

NOTE: The remaining primary lead connection is determined by the type of ignition system being tested. Refer to the appropriate inset drawing, and perform only the following step that agrees with your system.

The primary lead clip should be connected to the distributor breaker points. This may be an external terminal on some distributors, while on others it may be the end of the pigtail lead from the distributor to the ignition coil. CAUTION: Do not use the insulation piercing feature of the primary lead clip unless it is impossible to make any other connection to the distributor breaker points.

STANDARD IGNITION SYSTEM (Inset #1)

- () Clip the primary lead clip to the breaker point terminal on the distributor or at the coil end of the connecting wire or pigtail lead.

CAPACITIVE-DISCHARGE SYSTEM (Inset #2)

- () Clip the primary lead clip to the breaker point terminal on the distributor or to the end of the lead coming from the distributor. Do not connect the primary lead to the ignition coil terminal.

work done on the ignition system, or to check the condition of various ignition components for preventive maintenance.

When you perform these checks, the answers to the following four questions will help you arrive at a satisfactory analysis.

1. Are the patterns normal in all respects?
2. If something is not normal, is it common to all cylinders?
3. How does the pattern differ from the normal?
4. In what zone does this difference occur?

In order to help answer these questions, you may find it necessary to observe some portion of the ignition pattern in greater detail. This can be accomplished by pulling the VERT POS control to its out position and/or turning the HORIZ EXP control in a clockwise direction.

If you wish to view the ignition patterns of all the cylinders simultaneously, push the HORIZ POS control to the IN position. This produces a display on the screen that represents all of the cylinder firing patterns superimposed one on top of the other. These superimposed primary and secondary patterns provide an overall display of the complete ignition system. The SEC mode displays patterns of the high voltage ignition circuits, while the PRI mode displays patterns of the low voltage ignition circuits.

Each cylinder firing pattern can be viewed separately by pulling the HORIZ POS control to the OUT position. This provides a parade display on the screen that will show each cylinder pattern, from left to right, in its normal firing order when the pickup assembly is clamped around the #1 spark plug wire. If you want to start the parade display with another cylinder, simply move the pickup assembly to the desired spark plug wire.

With the Analyzer in the parade mode, you can adjust the HORIZ EXP and HORIZ POS controls to display a horizontally expanded view of each firing pattern. If the VERT POS control knob is pulled out, the firing patterns will also be vertically doubled in size. This can prove very important to your analysis and provide a highly detailed view of any desired area of one of the firing patterns.

Dwell angle in degrees can be measured using the dwell scales printed on the screen. Dwell readings should be taken with your Analyzer set up for a superimposed primary pattern. With this pattern, variations (such as cam wobble) can be easily identified by a multiple points close indication.

The various test procedures described in this section of the Manual have been tried and found completely satisfactory on many internal combustion engines. As you develop added skill with your Analyzer, you will find other tests that can be made that will help you quickly diagnose difficult to locate ignition problems.

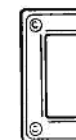
Ignition Test Procedure

- () A. Connect your Analyzer to the ignition system you want to test. If necessary, refer to "Analyzer Connection Procedure."
- () B. Perform the "preoperation adjustments" as outlined on Page 55.

WARNING: Before you start the engine in the next step, be sure the Pickup Cable and its leads and clips are away from the engine cooling fan, drive belts and pulleys, and exhaust manifold.

- () C. Start the engine and adjust it to the idle rpm listed in the manufacturer's specifications.
- () D. Set the Analyzer's controls to give a superimposed secondary display, with the pattern centered on the screen and spread between the lines marking each end of the dwell scales.
- () E. Compare the display pattern produced by the system under test with that of a normally operating system. If the ignition system is operating correctly, there will be no outstanding discrepancies over any portion of the displayed pattern. If one or more discrepancies are noted, compare the displayed pattern with the normal standard ignition system patterns on Pages 50 and 51, or the normal capacitive-discharge ignition system patterns on Page 53.
- () F. If every cylinder appears to be affected, the difficulty will be in a part of the ignition system that is common to all cylinders. In this case, push in the HORIZ POS control to obtain a superimposed primary or secondary pattern. Then adjust the HORIZ EXP and HORIZ POS controls to spread and position the pattern so the trace covers the screen. The VERT POS control may be pulled to the OUT position for an even more detailed view.
- () G. After the difficulty has been diagnosed, repair the system. After repairs have been made, check with the Analyzer to insure that no additional difficulties exist.
- () H. If all cylinders do not appear to be affected, the difficulty will be located in that part of the ignition system that is common to the affected cylinder(s). In this case, pull the HORIZ POS control to obtain a parade pattern of all cylinders. The first pattern on the left side of the screen is for the #1 cylinder, provided the pickup assembly is clamped to the #1 spark plug wire. The remaining patterns are presented in their normal firing order. Detailed examination of the firing pattern for the affected cylinder may be accomplished in the following manner:

1. Center the affected pattern on the cross mark at the center of the CRT screen.
2. Adjust the HORIZ EXP control fully clockwise; then pull out on the VERT POS control knob. This will provide maximum expansion of the pattern.



you may find it
ignition pattern in
ed by pulling the
and/or turning the
on.

Ignition Test Procedure

- WARNING:** Before you start the engine in the next step, be sure the Pickup Cable and its leads and clips are away from the engine cooling fan, drive belts and pulleys, and exhaust manifold.

- () H. If all cylinders do not appear to be affected, the difficulty will be located in that part of the ignition system that is common to the affected cylinder (s). In this case, pull the HORIZ POS control to obtain a parade pattern of all cylinders. The first pattern on the left side of the screen is for the #1 cylinder, provided the pickup assembly is clamped to the #1 spark plug wire. The remaining patterns are presented in their normal firing order. Detailed examination of the firing pattern for the affected cylinder may be accomplished in the following manner:

1. Center the affected pattern on the cross mark at the center of the CRT screen.
2. Adjust the HORIZ EXP control fully clockwise; then pull out on the VERT POS control knob. This will provide maximum expansion of the pattern.

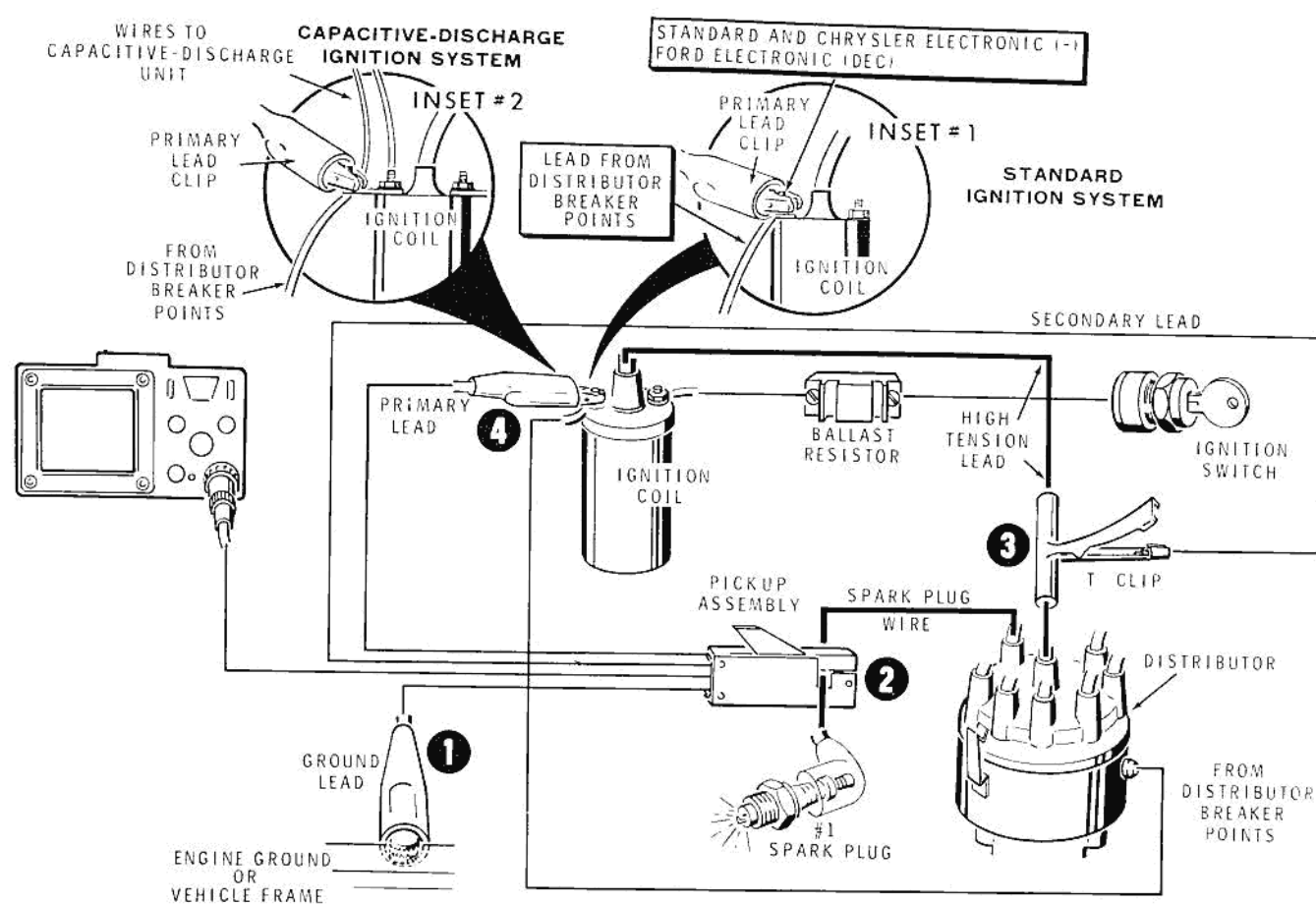


Figure 9



3. Determine the cause of the trouble by careful and detailed examination of the affected area of the pattern. Then make the necessary repairs to the ignition system.
4. Check each firing pattern by adjustment of the HORIZ POS control to make sure no additional trouble exists.

NOTE: It is not necessary to disconnect the Analyzer from the engine while you make adjustments on the engine under operating conditions. In this way, any ignition adjustments can be monitored on the scope while the adjustments are being made.

IN CASE OF DIFFICULTY

The following paragraphs deal with difficulties that might occur during the "Tests and Adjustments" and which must be corrected before the kit can be placed in normal operation. This type of difficulty is usually due to an assembly error or to an improperly soldered connection. The following checks should help you locate an error of this type if one has been made.

1. Make a careful visual check of the complete unit for any obvious error that may have been made, such as improperly soldered connections, wiring errors, bare wires touching each other, etc. Look for bits of solder, pieces of wire, or other foreign matter lodged in the wiring or components that could cause trouble. Carefully check all points where several connections are made to make sure all wires are properly soldered.
2. Make sure each wire or lead is connected to the proper place. It is quite helpful to have another person check your work. Someone unfamiliar with the unit will often notice an error that you have overlooked.
3. Carefully check all solder connections to make sure they are tight and shiny. About 90% of the kits that are returned to Heath Company for service operate

improperly due to poor solder connections. Reheat questionable connections and, if necessary, apply a little more solder to make sure all connections are soldered as described in the "Kit Builders Guide."

4. Check the values of the parts. Be sure the proper parts have been wired into each circuit as shown in the Pictorial Diagrams. It would be easy, for example, to install a 3300 Ω (orange-orange-red) resistor where a 330 k Ω (orange-orange-yellow) resistor should have been installed.
5. If a voltmeter is available, check the voltage readings against those shown on the Schematic Diagram. A review of the "Circuit Description" may help you locate the trouble.
6. If the difficulty is not located after the above checks have been made, refer to the information in the "Troubleshooting Chart" on the following pages.

In an extreme case where you are unable to resolve a difficulty, refer to the "Customer Service" information inside the rear cover of the Manual. Your Warranty is located inside the front cover.

Troubleshooting Chart

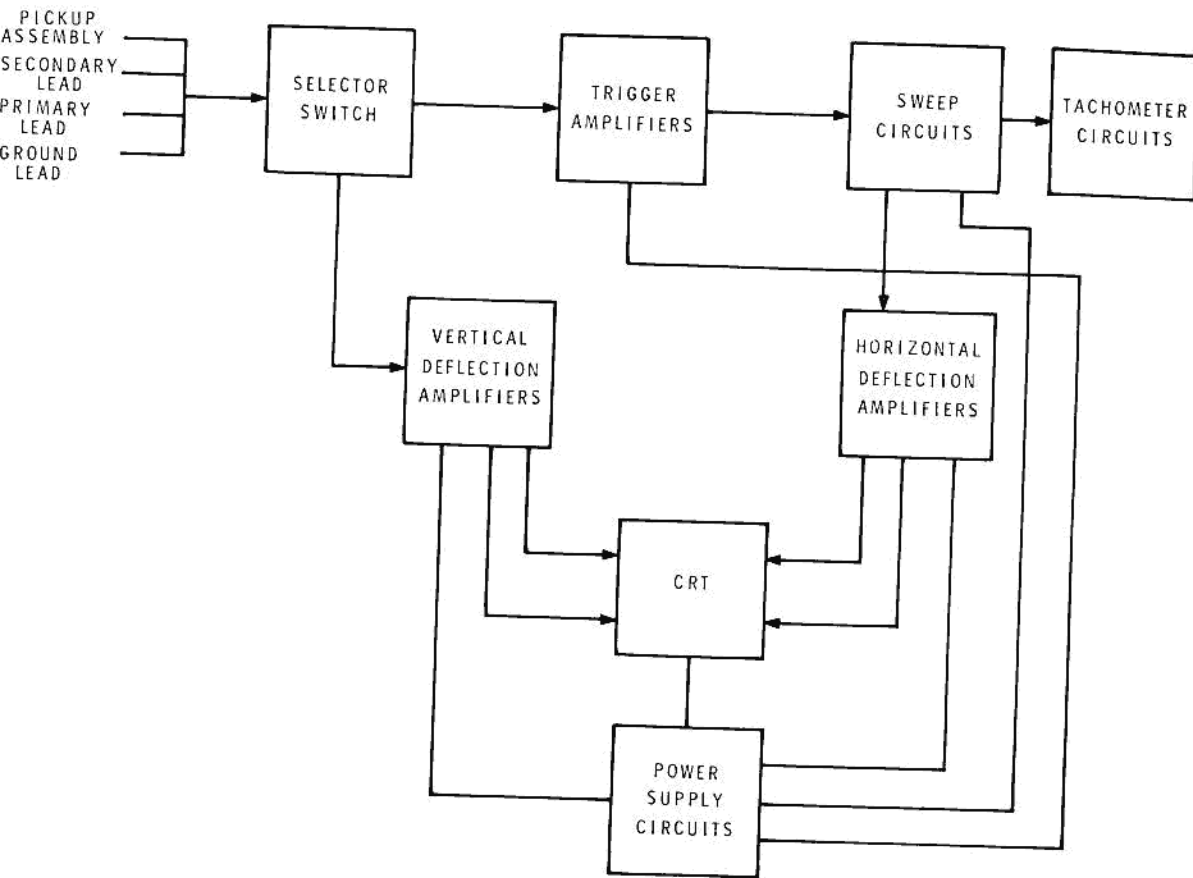
TROUBLE	POSSIBLE CAUSE
Panel lamp not lit.	<ol style="list-style-type: none"> 1. Fuse not installed. 2. Wiring error at power transformer. 3. Diode D903 open. 4. C202 or C203 shorted. 5. Short in 250 volt power supply.
Panel lamp not lit. CRT filament lighted.	<ol style="list-style-type: none"> 1. See 3, 4, and 5 above. 2. Defective panel lamp.
Fuse blows.	<ol style="list-style-type: none"> 1. Wiring error. 2. Shorted or improperly connected diode: D901, D902, or D903. 3. Shorted C202 or C203.
No horizontal trace in calibrate position. Does not function on engine.	<ol style="list-style-type: none"> 1. Trigger Adjust control R302, not adjusted correctly. 2. Trigger circuit Q301 through Q303 defective. 3. Trigger circuit: resistor of incorrect value. 4. Wiring error at Selector switch. 5. Horizontal amplifier: defective transistor Q701 through Q703. 6. Defective sweep transistor: Q401 through Q409. 7. Sweep circuit: incorrect value resistor.
No horizontal deflection in calibrate position only.	<ol style="list-style-type: none"> 1. Wiring error: Selector switch. 2. Transistor Q601 defective. 3. Incorrect value resistor: R601 through R604.
No vertical deflection any position. (Vertical position control functions correctly.)	<ol style="list-style-type: none"> 1. Wiring error at SW1. 2. Capacitor C801 open.
No vertical deflection. Vertical position control does not function properly.	<ol style="list-style-type: none"> 1. Defective transistor: Q801 through Q804. 2. Vertical amplifier; resistor of incorrect value.

TROUBLE	POSSIBLE CAUSE
No horizontal or vertical deflection.	<ol style="list-style-type: none"> 1. Defective component or wiring error in 15V or 250V supply. 2. Check for proper voltage at collector and emitter of Q901. NOTE: This is test point TP2 of Figure 1 on Page 42.
Blurred trace (poor focus). Spot improper shape (poor focus).	<ol style="list-style-type: none"> 1. Incorrect value of R902, R904, R905, or R906. 2. Defective Focus control R102. 3. Defect in 250 volt supply. 4. Wiring error at CRT socket cable breakout. 5. Defective Astigmatism control, R101.
No horizontal expansion.	<ol style="list-style-type: none"> 1. Open or incorrect value R704. 2. Defective expand control, R5. 3. Wiring error.
Improper vertical height.	<ol style="list-style-type: none"> 1. Vertical expand switch SW2 shorted or incorrectly wired. 2. Resistor R806 or R14 of incorrect value.
Trace too dim or too bright.	<ol style="list-style-type: none"> 1. Defective component in high voltage supply. 2. R902 incorrect value.
NOTE: The following conditions only apply to the Tachometer section of the Analyzer.	
No meter deflection.	<ol style="list-style-type: none"> 1. SW3B in parade position. (Horizontal Position control knob pulled out.) 2. Diode D501 shorted. 3. No signal applied to C501. 4. Capacitor C501 open. 5. Transistor Q501 or Q502 defective. 6. Meter defective.
Unable to calibrate.	<ol style="list-style-type: none"> 1. Resistor values incorrect: R7 through R10. 2. Open Calibrate control R503. 3. TAC switch incorrectly installed.

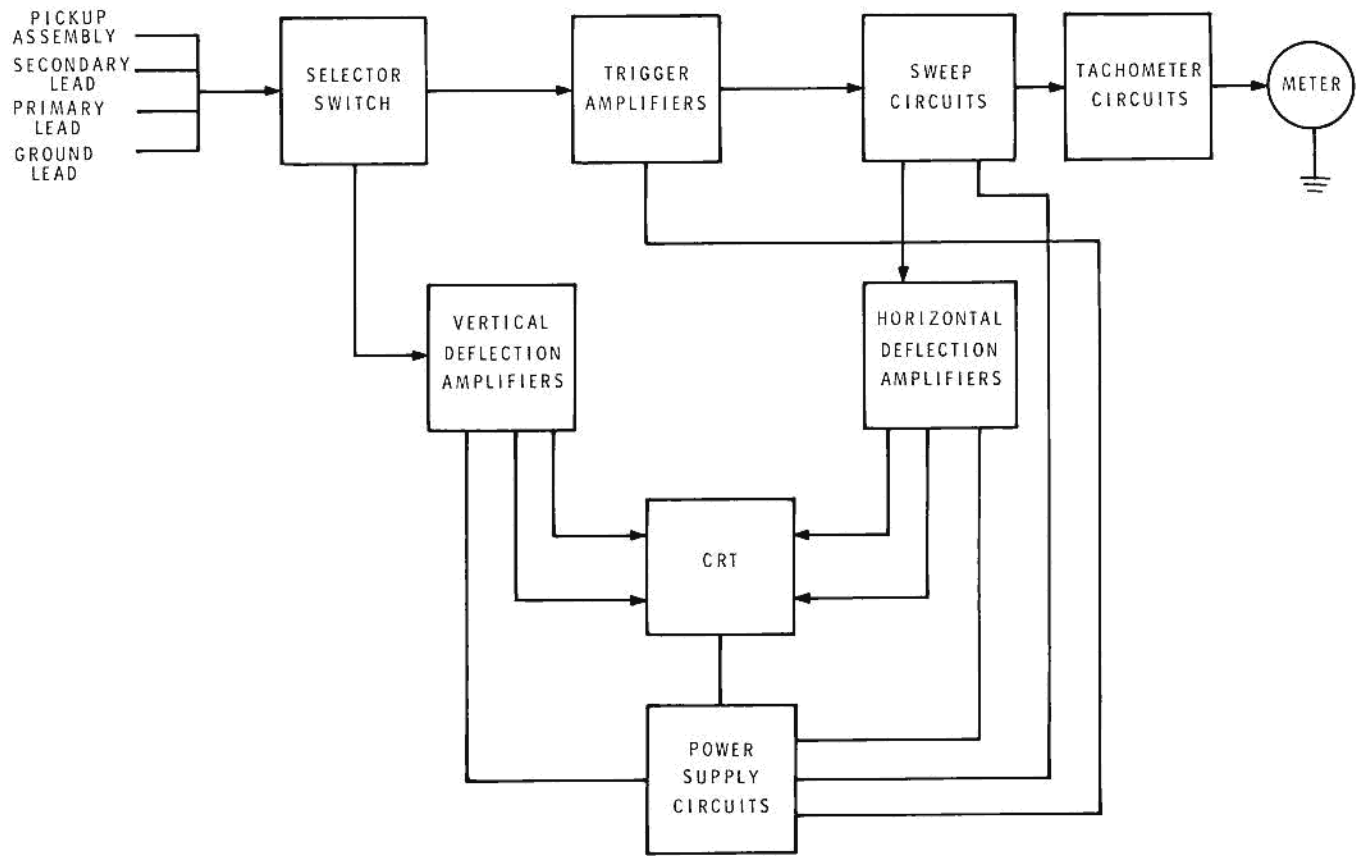
SPECIFICATIONS

VISUAL DISPLAY

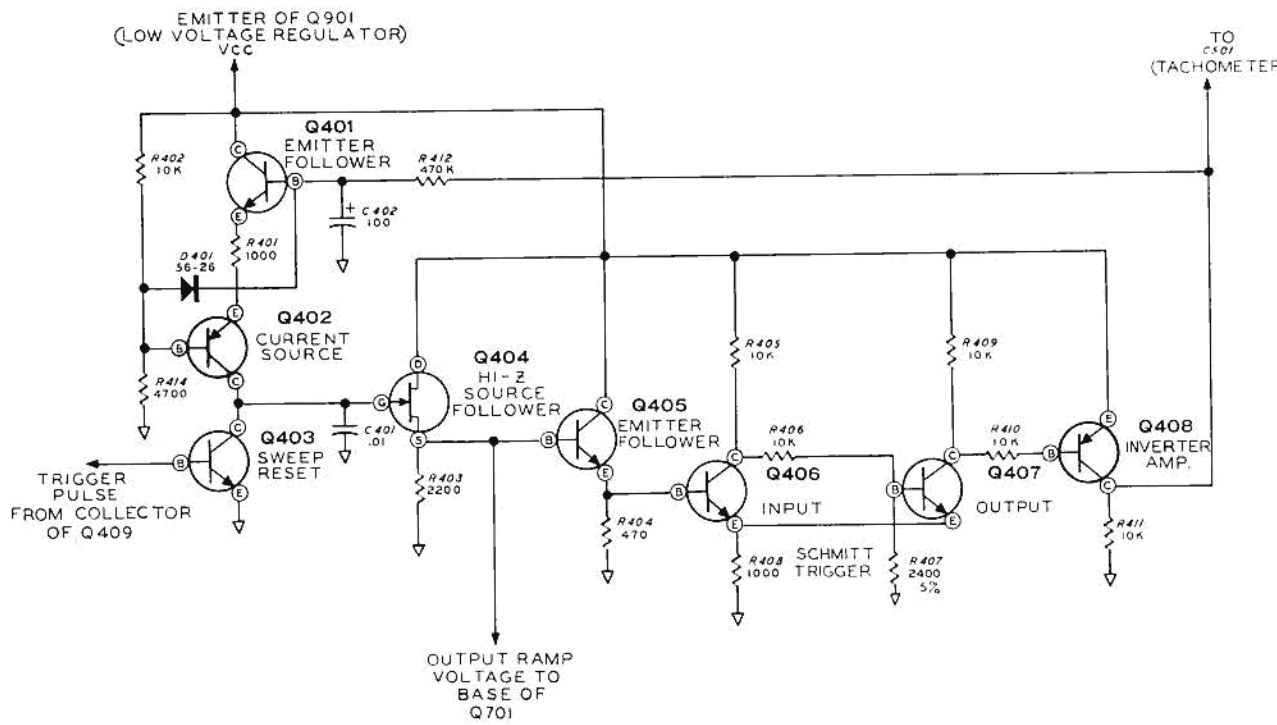
Display Tube (CRT)	5DEP1F.
Circuitry	Solid-state: 24 transistors and 9 diodes, plus 5" diameter CRT.
Engine Cylinders	3, 4, 6, or 8.
Ignition Systems	Standard, transistor, or capacitive-discharge.
Dwell Scales	3, 4, 6, or 8 cylinder; scales marked on graticule.
Sweep Length	±5% over entire rpm range (Referenced to Calibrate position).
Intensity	Fixed.
Preset Controls	Focus. Astigmatism (spot shape). Trigger adjust. Tachometer calibrate.
Front Panel Controls	Vertical position (pull to expand). Horizontal expand (pull for 6 cylinder tachometer). Horizontal position (pull for parade display). Selector switch. Standard (or transistorized) ignition: primary, secondary. Capacitive-discharge ignition: primary, secondary. Calibrate. Power switch; on-off.



BLOCK DIAGRAM



BLOCK DIAGRAM



PARTIAL SCHEMATIC



DISPLAY SHOWS

Primary	Waveform across breaker points.
Secondary	Waveform in secondary circuit.
Parade	Primary or secondary waveform for each cylinder.
Superimposed	Primary or secondary waveform for all cylinders.
Expanded Viewing	One or all cylinders in sequence. Vertical Expand: Approximately X2; switch operated. Horizontal Expand: Approximately X10; rotate control to operate.

TACHOMETER

Meter Ranges	Low, 0-1,000 rpm; high, 0-5,000 rpm.
Cylinders	Calibrated for 6 and 8-cylinder, four-cycle engines. For 3 and 4 cylinder engines, use 6 and 8 cylinder switch positions respectively. Then double meter reading for correct engine rpm.

GENERAL

Trigger Method	Primary pickup for superimposed patterns. Secondary (Clamp-on) inductive pickup for parade patterns.
Cable Lengths	To pickup clamp: 12 feet. Pickup clamp to ground, primary and secondary leads: 2 feet each.
Power Supply	CRT high voltage; silicon rectifiers. Transistor low voltage supply; regulated.
Power Requirements	110-130 Vac or 220-260 Vac, 50/60 Hz, 16 watts.
Overall Dimensions	10-3/8" wide x 7-1/4" high x 17-1/2" deep.
Net Weight	14-1/2 lbs.

The Heath Company reserves the right to discontinue instruments and to change specifications at any time without incurring any obligation to incorporate new features in instruments previously sold.

CIRCUIT DESCRIPTION

Refer to the Schematic Diagram (fold-out from Page 75) and to the Block Diagram (fold-out from Page 64) while you read this "Circuit Description."

Components are numbered in the following groups.

1-99	Parts mounted on the front panel.
101-199	Parts mounted on the rear panel.
201-299	Parts mounted on the chassis.
301-999	Parts mounted on the circuit board as follows:
301-399	Trigger circuit.
401-499	Sweep circuit.
501-599	Tachometer.
601-699	Calibrate circuit.
701-799	Horizontal amplifier.
801-899	Vertical amplifier.
901-999	Power supply.

The Heathkit Model CO-1015 Solid-State Ignition Analyzer is composed of the following circuits: trigger, calibrating signal, sweep, vertical deflection amplifier, horizontal deflection amplifier, tachometer, and power supply.

TRIGGER CIRCUIT

The trigger circuit consists of transistors Q301 through Q304 and their associated circuitry. With Selector switch SW1 in the SEC position (either STD IGN or C-D IGN mode) and SW3A in the PARADE mode, the signal from the #1 spark plug wire is picked up by the clamp-on pickup assembly and fed to the base of Q301 through lug 2 of the cable connector socket, C301, R301, and R302. The signal

is then amplified by Q301, Q302, and Q303. The output of Q303 triggers the sweep circuit. At the same time, the signal from the secondary lead T clip passes through SW1, to C801, R801, and to the base of Q802, the vertical deflection preamplifier.

With Selector switch SW1 in the PRI position (either STD IGN or C-D IGN mode) and SW3A still in the PARADE mode, the signal from the breaker points is picked up by the primary lead and applied through lug 4 of the cable connector socket to SW1. From SW1, this signal again passes to Q802 and the signal from the clamp-on pickup assembly again passes to Q301, Q302, Q303, and triggers the sweep circuit.

With Selector switch SW1 in the standard ignition SEC position and switch SW3A pushed in (superimposed mode), the signal from the primary lead passes through R2 and R12 to SW1R and SW3A; then to the base of Q304. From Q304, the signal passes through C302 and R302 to Q301, Q302, and Q303. The output of Q303 triggers the sweep circuit. At the same time, the signal from the secondary lead T clip passes through switch SW1F to C801, R801, and the base of Q802. In the C-D IGN mode of SW1, the signal from the primary lead passes directly to SW1R lugs 1 and 12; then to SW3A and Q304. The signal from the secondary lead passes through SW1F lugs 2 and 6, to Q802. With Selector switch SW1 in standard ignition PRI position, and SW3 pushed in, the signal from the primary lead is applied through R2 and R12 to SW1R and through SW3A to the base of Q304. At the same time, this signal also passes through SW1F to C801, R801, and the base of Q802. In the corresponding C-D IGN mode PRI position SW1, the signal from the red clip lead is applied directly to switch SW1R lugs 1 and 12 and to SW3A and Q304. At the same time, this signal also passes through SW1F lugs 5 and 6, C801, and R801 to Q802.



CALIBRATING SIGNAL

Q601, an overdriven amplifier, receives a 60 Hz signal from the low voltage winding of the power transformer. This 60 Hz signal is applied to a voltage divider consisting of R602 and R603. The signal taken from the junction of R602 and R603 is connected to lug 7 of SW1F. From lug 7, the signal is fed to vertical preamplifier Q802.

The output of Q601 is a clipped sine wave which is applied to lug 10 of SW1R. In the calibrate position of the selector switch, and with the horizontal position control knob pushed in, this clipped sine wave signal is applied through SW3A to Q304 and used to trigger the sweep circuits.

SWEEP CIRCUIT

The sweep circuit is designed to maintain a constant horizontal width regardless of the frequency of the incoming signal. This eliminates the necessity of recalibrating the sweep width every time the engine rpm changes. To prevent the horizontal width (sweep amplitude) of the trace from changing when the engine speed varies, the charging current to sweep forming capacitor C401 is adjusted automatically. This compensates for rpm variations because the voltage across C401 does not change and the sweep width stays the same.

To change the charging current of C401, the sweep circuit generates a ramp voltage of constant amplitude and variable repetition rate. As shown in the partial schematic (fold-out from Page 64), the sweep circuit consists of a current source (Q402); a Schmitt trigger circuit (Q406, Q407); an integrator circuit (C402, R412); the sweep forming capacitor, C401; and a reset switching transistor, Q403.

When the circuit operates at a given reset pulse repetition rate (engine rpm constant), the voltage developed across the sweep forming capacitor, C401, is a linear ramp voltage with a peak voltage of E. The Schmitt trigger is designed to have a firing point at E/2. This results in a symmetrical square wave at the output of the Schmitt trigger.

For any particular reset pulse repetition rate (F), the Schmitt trigger establishes 1/F to be the reference unit time (T). This is to maintain E constant for any value of 1/F. With the firing voltage E/2 of the Schmitt trigger constant, E/2 must occur at time F/2 to maintain a Symmetrical

square wave at the output of the Schmitt trigger (Q407). The square wave output of Q407 is applied to the integrator circuit which converts the square wave to a dc output (used to control the current source) proportional to the duty cycle of the square wave. This allows the gain of the current source to be high. As the current from the current source is changed, the change in duty cycle due to frequency changes will decrease and the peak voltage across the sweep forming capacitor can be held constant.

Q409 prevents the trigger circuit from operating on any signal pulse other than the actual plug firing signal.

VERTICAL DEFLECTION AMPLIFIER

The preamplifier and output stages of the vertical deflection amplifier operate as differential amplifiers. A signal pulse from either the secondary lead T clip or the primary lead is routed to the base of Q802 by selector switch SW1. Q802 conducts and its emitter voltage increases. This increased voltage is applied to the emitter of Q801 and reduces the forward bias of Q801 and increases its collector output voltage. The signal at the collector of transistor Q801 is 180 degrees out of phase with the signal at the collector of Q802. This then forms the push-pull type of preamplifier required to drive the vertical output transistors, Q803 and Q804, and the CRT vertical deflection plates. Vertical position control R4 positions the trace by applying a dc voltage to the base of Q801. This causes a dc unbalance in the preamplifier and output amplifier. SW2, the vertical expand switch, places R14 between the emitters of Q801 and Q802 when the switch is pulled out. This doubles the vertical amplitude of the trace. With the vertical expand switch in its normal pushed-in position, emitter resistors R804, R805, and R806 establish the dc gain of the vertical preamplifier. R811, R812 and R819 establish the dc gain of the vertical output amplifier, Q803 and Q804.

HORIZONTAL DEFLECTION AMPLIFIER

The operation of the horizontal amplifier is similar to that of the vertical amplifier. However, the horizontal amplifier does not have a preamplifier stage.

The sweep signal from the sweep circuit and emitter follower Q701 is amplified by the horizontal differential amplifier, Q702 and Q703. The push-pull output of Q702 and Q703 is applied to the horizontal deflection plates of



the CRT. This causes the electron beam to sweep across the face of the CRT and produce a trace. The horizontal sweep rate of the electron beam is determined by the frequency of the trigger signal.

R6, the horizontal position control, varies the dc voltage applied to the base of Q703. This causes a dc unbalance in the horizontal amplifier and determines the horizontal position of the trace.

Horizontal expand control R5 varies the coupling between the emitters of Q702 and Q703 which determines the gain of the horizontal amplifier. Therefore, horizontal deflection (sweep width) is determined by the setting of the horizontal expand control.

TACHOMETER

NOTE: The meter pointer momentarily will indicate full scale and then return to zero when the Analyzer is first turned on. This is due to the initial surge of charging current through capacitor C502, resistors R502, R503, and meter M1 and will not damage the meter.

Capacitor C501 and the resistor network consisting of R7, R8, R9, and R10, form an RC timing circuit. When a pulse from the output of Q408 is applied to C501, the capacitor will charge. The capacitor will then discharge through the resistive network selected by switches SW4, SW5A, and SW5B. The frequency of the pulses applied to C501 determines the charge/discharge repetition rate of the RC timing circuit. The output of the timing circuit is a pulse which is applied to the base of pulse amplifier transistor Q501. The input signal to the base of Q502 is a rectangular pulse with its width determined by the time constant of the RC timing circuit selected by the position of the TAC switch and the 6/8 cylinder switch. The width of the pulse remains constant for any given setting of the TAC or 6/8 cylinder switch. The repetition rate of this pulse is determined by the frequency of the trigger pulse from the output of Q408.

When Q502 is turned off (no input signal), C502 will be fully charged. At this time, the voltage at the collector of Q502 will be zero with respect to ground. When a trigger pulse from Q408 is applied to C501, the resulting rectangular pulse at the base of Q502 will turn it on and partially discharge C502 through R502, R503, and M1 to

ground and cause the meter pointer to move up-scale. An increase in the repetition rate of the trigger pulses, caused by an increase in engine rpm, will turn Q502 on more frequently and cause C502 to discharge more frequently. The output of Q502 will therefore be an integrated (averaged) dc voltage proportional to the pulse width and repetition rate of the rectangular pulse applied to the base of Q502. The meter scales will indicate this voltage output in terms of engine rpm.

POWER SUPPLY CIRCUITS

AC power is applied through the ON-OFF switch and slow-blow fuse to the dual primary windings of the power transformer. These windings should be connected in parallel for 120 volt operation and in series for 240 volt operation.

A high voltage secondary winding is connected to a voltage-doubler circuit that consists of D904, D905, C204, and C205. The output of this high voltage circuit, which is negative with respect to ground (chassis), is filtered by R901 and C902, and applied through R903 to the CRT grid. The negative output of this high voltage supply is also connected to a voltage divider, R904, R102, R906, and R905. Control R102 applies a negative voltage to the focusing anode of the CRT.

Another secondary winding is connected to a half-wave rectifier-filter-network consisting of D903, C203, R201, and C202. Resistor R202 is a bleeder resistor, while R13 limits the current through the panel lamp. The positive 250 volt output of this power supply circuit is applied across R101, the astigmatism control, which applies a portion of the voltage to the screen grid (pin 8) of the CRT. This positive 250 volt output is also the supply voltage for the horizontal and vertical deflection circuits.

A low voltage center-tapped secondary winding is connected to a full-wave rectifier-filter-network consisting of D901, D902, and C201. The positive output of this power supply circuit is regulated by transistor Q901 and zener diode D906. This regulated output is the supply voltage for the Analyzer's trigger amplifiers, sweep circuits, control circuits, and tachometer circuit.

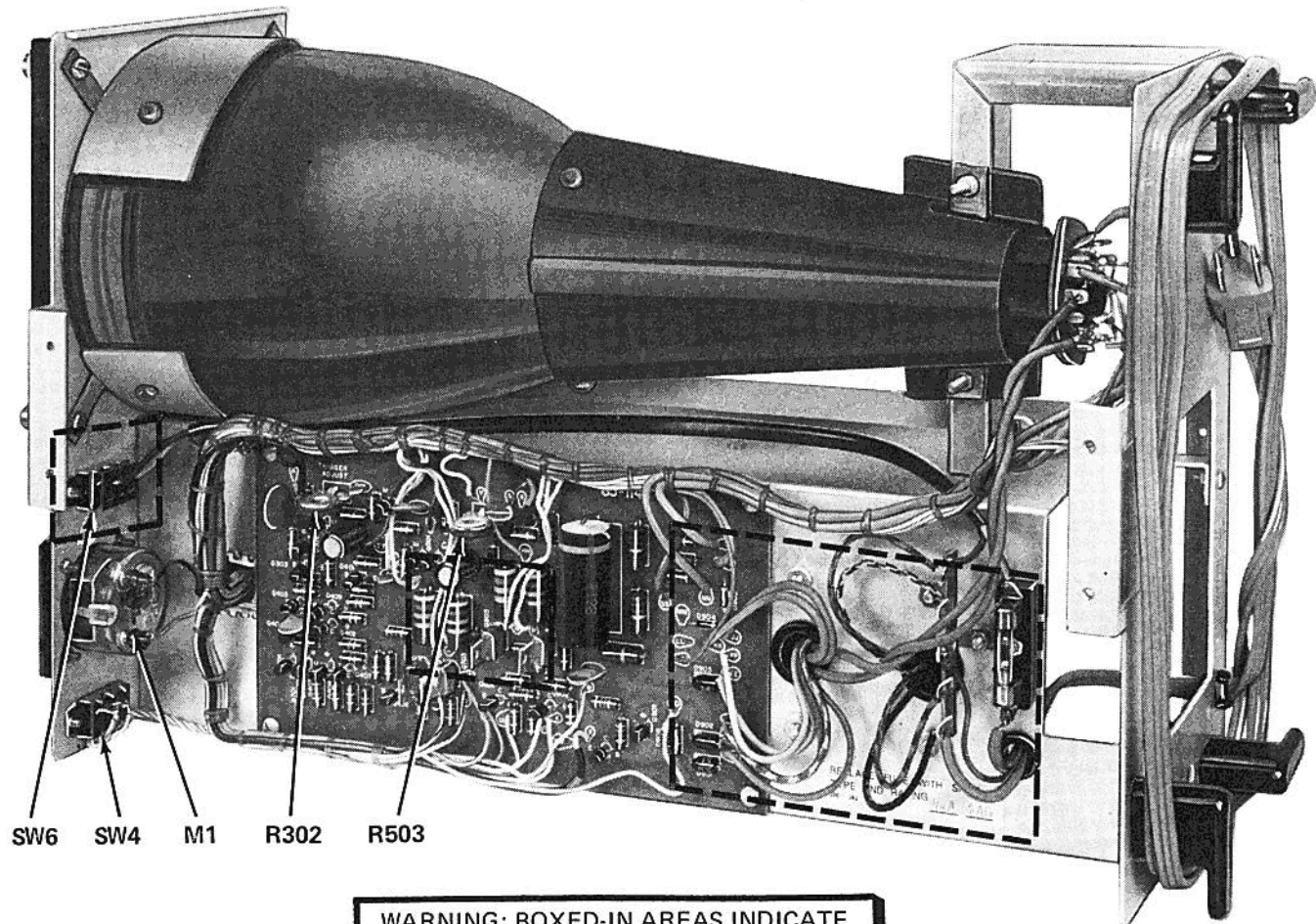
A separate 6.3 Vac winding supplies the CRT filament voltage. This winding is insulated to withstand in excess of two thousand volts because the negative high voltage applied to the grid (pin 2) of the CRT is also applied to the filament lead connected to pin 1 of the CRT.



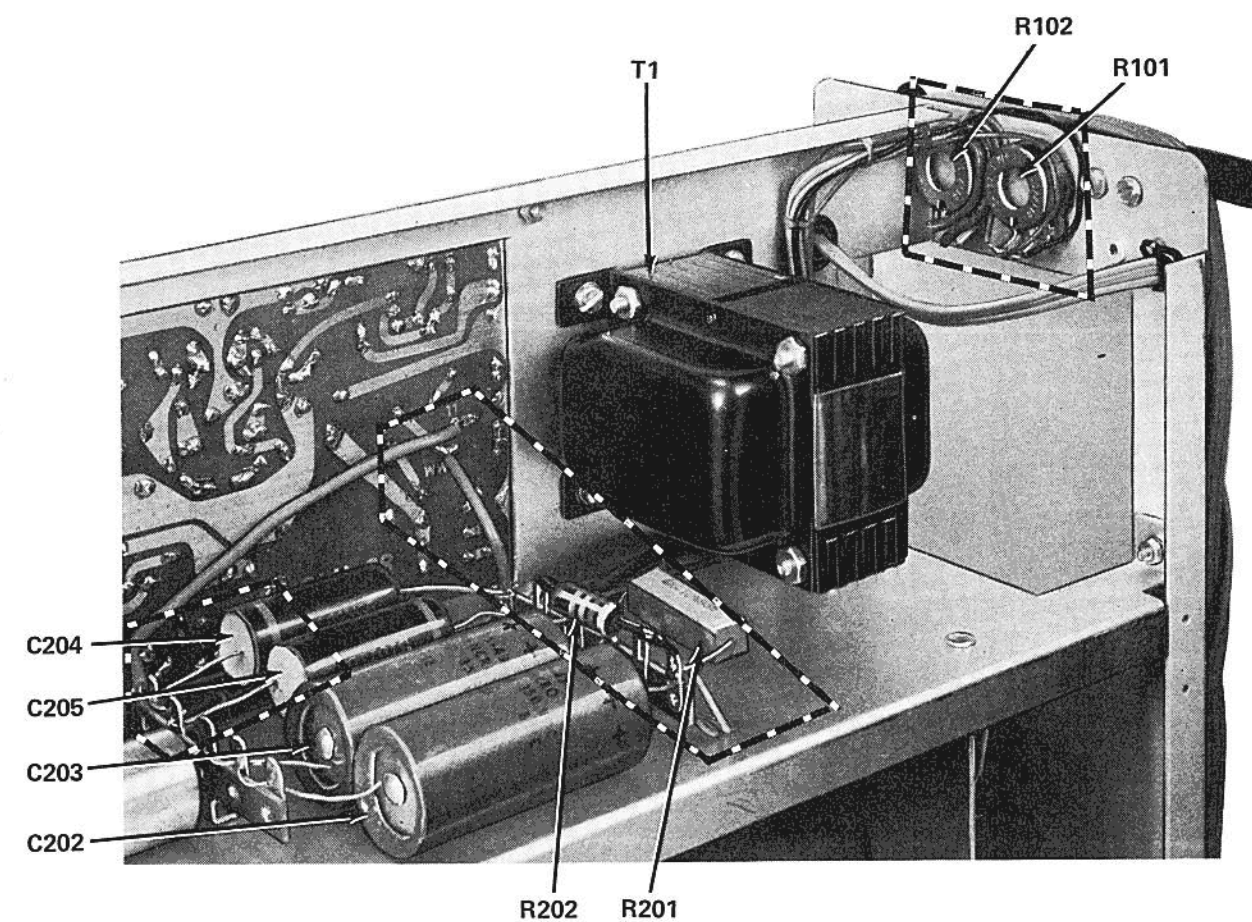
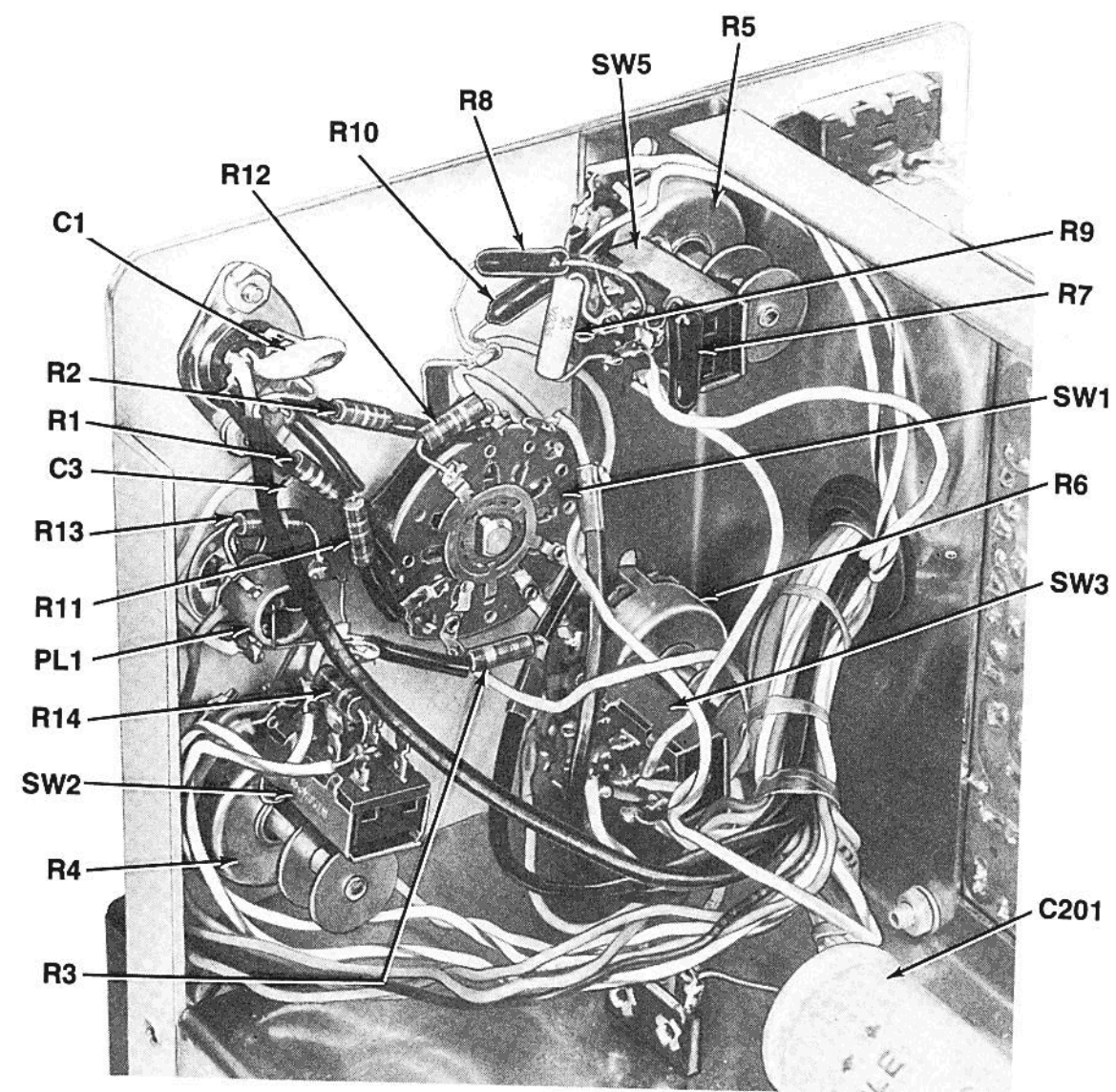
TRANSISTOR AND DIODE CROSS REFERENCE CHART

DESIGNATION	IDENTIFICATION	HEATH NUMBER	TYPE NUMBER
Q304, Q401, Q403, Q405, Q406, Q407, Q601, Q801, Q802, Q901	 EMITTER E BASE B COLLECTOR C	417-118	2N3393
Q301, Q302, Q303, Q402, Q408, Q501, Q502, Q701	 EMITTER E BASE B COLLECTOR C	417-201	X29A829 D29A4 2N3906
Q404	 DRAIN D GATE G SOURCE S	417-241	EL131
Q702, Q703, Q803, Q804	 EMITTER E B C COLLECTOR BASE B	417-834	MPSU10
D904, D905 (2KV)		57-52	5D20
D901, D902, D903		57-27	1N2071
D701 (4.7V ZENER)		56-59	1N750A
D401		56-26	1N191
D906 (15V ZENER)		56-25	1N4166A

CHASSIS PHOTOGRAPHS



WARNING: BOXED-IN AREAS INDICATE
HAZARDOUS VOLTAGE LOCATIONS.

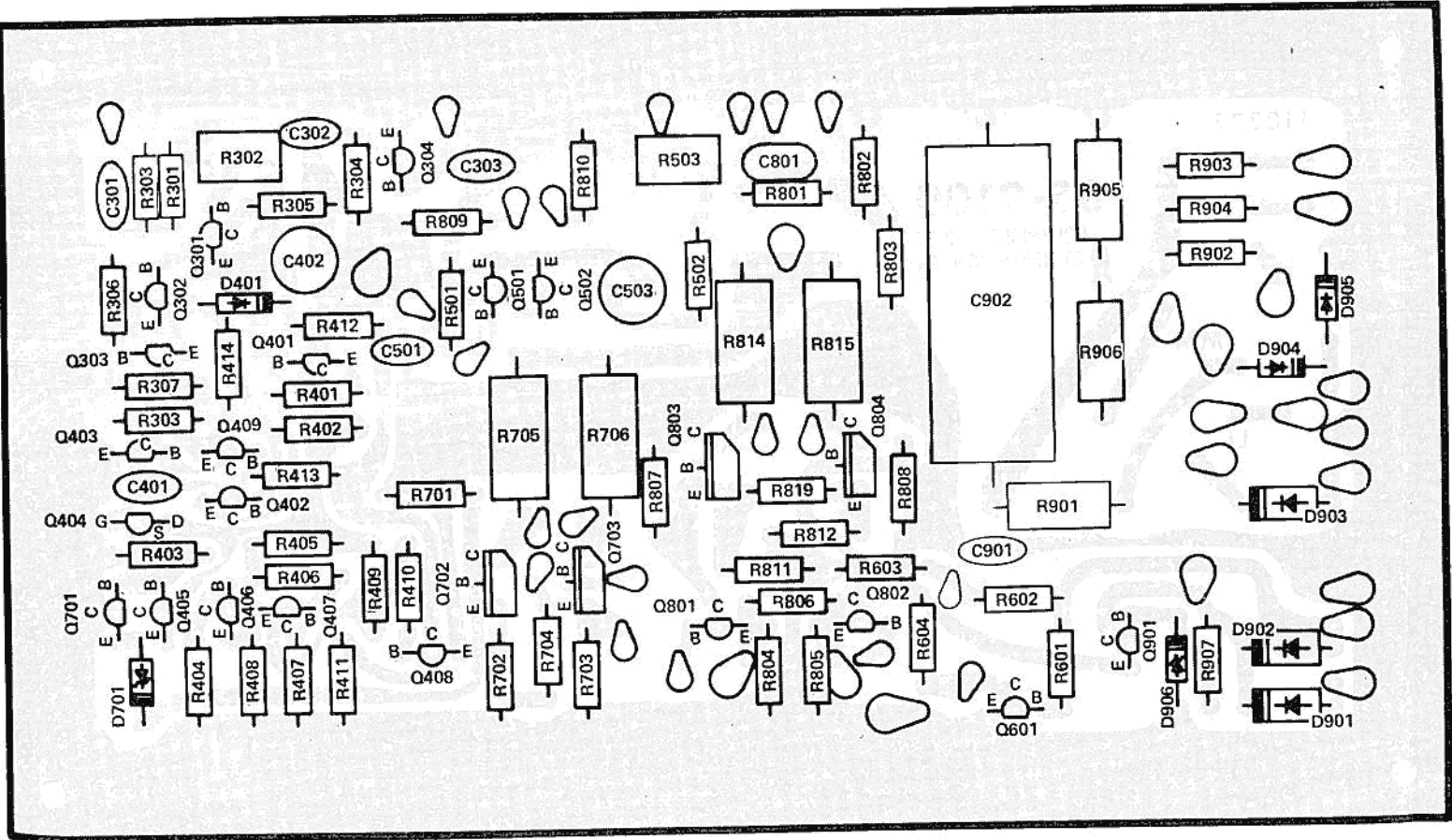


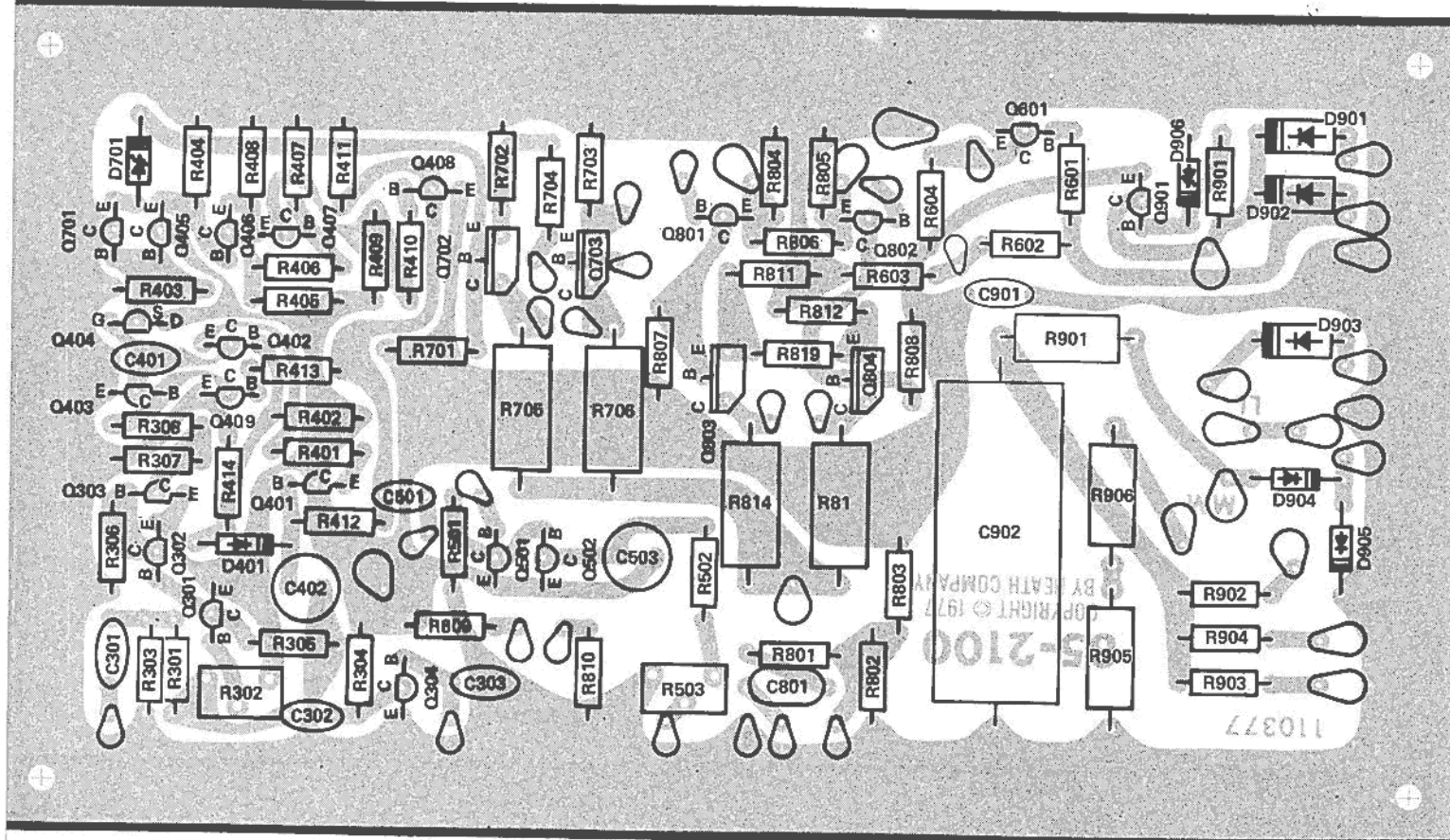
WARNING: BOXED-IN AREAS INDICATE
HAZARDOUS VOLTAGE LOCATIONS.

CIRCUIT BOARD X-RAY VIEWS

NOTE: To determine the value (22 k Ω , .05 μ F, etc.) of one of these parts, you may proceed in either of the following ways.

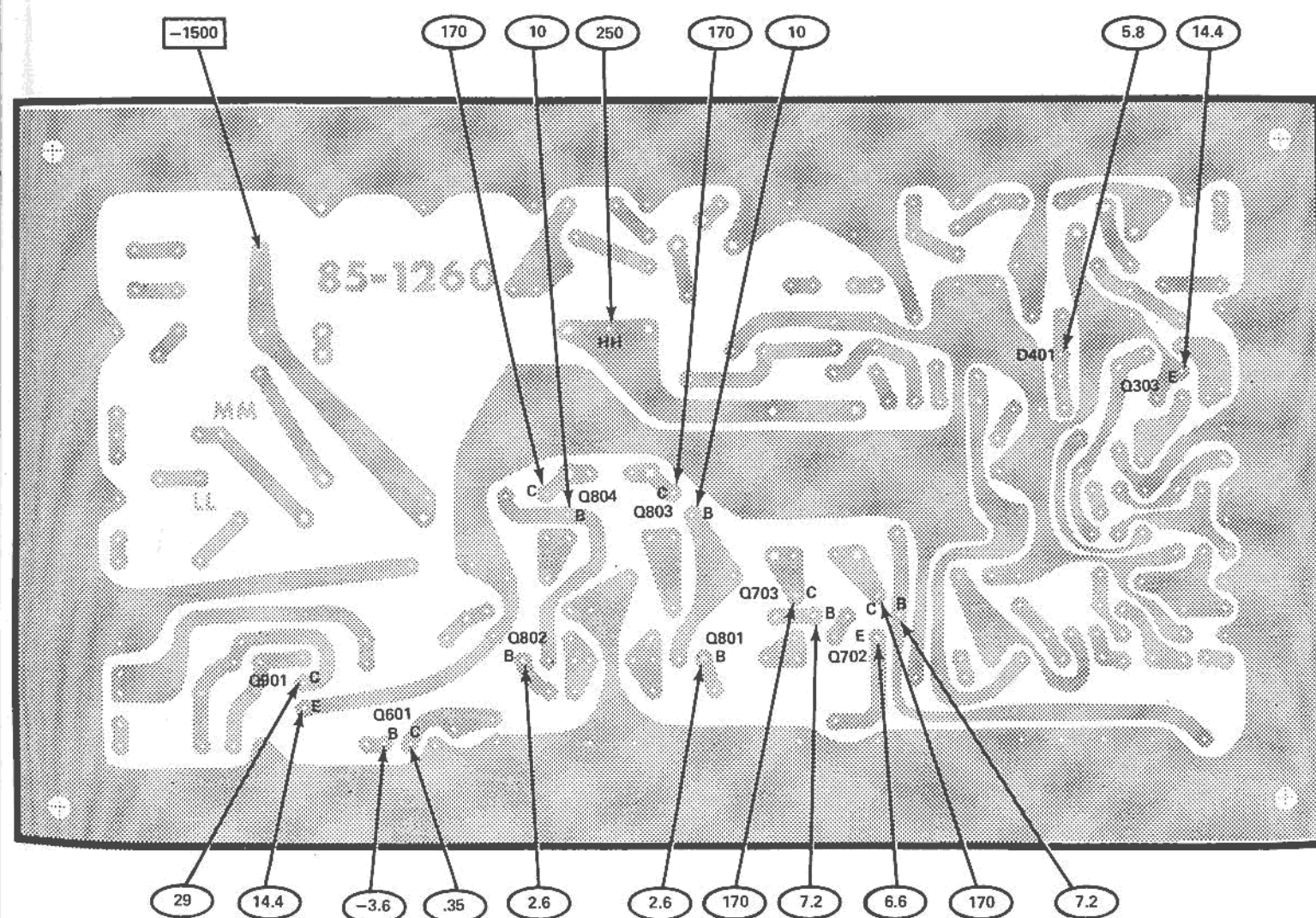
1. Refer to the place where the part is installed in the Step-by-Step instructions.
2. Note the identification number of the part (R-number, C-number, etc.). Then locate the same identification number next to the part on the Schematic. The value, or "Description," of most parts will be near this number. For diodes and transistors, refer to the transistor-diode identification chart.



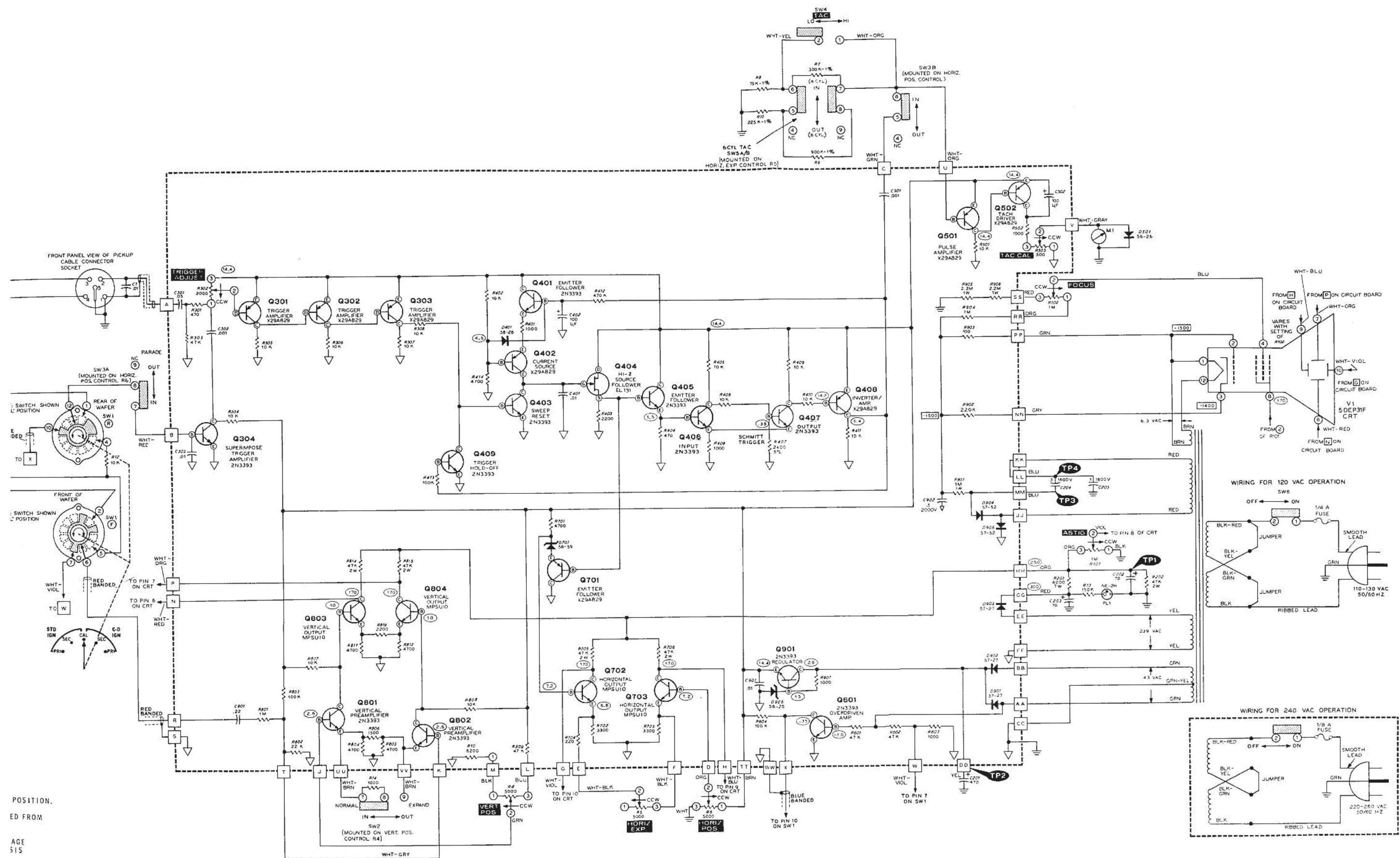


(VIEWED FROM FOIL SIDE)

VOLTAGE CHART



**SCHEMATIC OF THE
HEATHKIT®
SOLID-STATE IGNITION ANALYZER
MODEL CO-1015**



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MODEL CO-1015

CUSTOMER SERVICE

REPLACEMENT PARTS

Please provide complete information when you request replacements from either the factory or Heath Electronic Centers. Be certain to include the **HEATH** part number exactly as it appears in the parts list.

ORDERING FROM THE FACTORY

Print all of the information requested on the parts order form furnished with this product and mail it to Heath. For telephone orders (parts only) dial 616 982-3571. If you are unable to locate an order form, write us a letter or card including:

- Heath part number.
- Model number.
- Date of purchase.
- Location purchased or invoice number.
- Nature of the defect.
- Your payment or authorization for COD shipment of parts not covered by warranty.

Mail letters to: Heath Company
Benton Harbor
MI 49022
Attn: Parts Replacement

Retain original parts until you receive replacements. Parts that should be returned to the factory will be listed on your packing slip.

OBTAINING REPLACEMENTS FROM HEATH ELECTRONIC CENTERS

For your convenience, "over the counter" replacement parts are available from the Heath Electronic Centers listed in your catalog. Be sure to bring in the original part and purchase invoice when you request a warranty replacement from a Heath Electronic Center.

TECHNICAL CONSULTATION

Need help with your kit? — Self-Service? — Construction? — Operation? — Call or write for assistance, you'll find our Technical Consultants eager to help with just about any technical problem except "customizing" for unique applications.

The effectiveness of our consultation service depends on the information you furnish. Be sure to tell us:

- The Model number and Series number from the blue and white label.
- The date of purchase.
- An exact description of the difficulty.
- Everything you have done in attempting to correct the problem.

Also include switch positions, connections to other units, operating procedures, voltage readings, and any other information you think might be helpful.

Please do not send parts for testing, unless this is specifically requested by our Consultants.

Hints: Telephone traffic is lightest at midweek — please be sure your Manual and notes are on hand when you call.

Heathkit Electronic Center facilities are also available for telephone or "walk-in" personal assistance.

REPAIR SERVICE

Service facilities are available, if they are needed, to repair your completed kit. (Kits that have been modified, soldered with paste flux or acid core solder, cannot be accepted for repair.)

If it is convenient, personally deliver your kit to a Heathkit Electronic Center. For warranty parts replacement, supply a copy of the invoice or sales slip.

If you prefer to ship your kit to the factory, attach a letter containing the following information directly to the unit:

- Your name and address.
- Date of purchase and invoice number.
- Copies of all correspondence relevant to the service of the kit.
- A brief description of the difficulty.
- Authorization to return your kit COD for the service and shipping charges. (This will reduce the possibility of delay.)

Check the equipment to see that all screws and parts are secured. (Do not include any wooden cabinets or color television picture tubes, as these are easily damaged in shipment. Do not include the kit Manual.) Place the equipment in a strong carton with at least THREE INCHES of *resilient* packing material (shredded paper, excelsior, etc.) on all sides. Use additional packing material where there are protrusions (control sticks, large knobs, etc.). If the unit weighs over 15 lbs., place this carton in another one with 3/4" of packing material between the two.

Seal the carton with reinforced gummed tape, tie it with a strong cord, and mark it "Fragile" on at least two sides. Remember, the carrier will not accept liability for shipping damage if the unit is insufficiently packed. Ship by prepaid express, United Parcel Service, or insured Parcel Post to:

Heath Company
Service Department
Benton Harbor, Michigan 49022



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